INDIAN AGRICULTURAL
RESEARCH INSTITUTE LIBRARY,
NEW DELHI.

SCIENCE *And* CULTURE

Published by the
INDIAN SCIENCE
NEWS ASSOCIATION

Editors
M N Saha
D M Bose   S K M
A C Uk I   P R

[illegible] Ed
A K Ghosh
R Chatterjee   B Mukherjee

[illegible]
S P Agharkar   Atma a
Basir Ahmad   K G Bagchi
A C Banerjee   K Bane
S K B rjee   K P Ba
D N Wadia   K V C
H P Bhaumik   K Biswas
C S Bose   N K Bose
D Chakravarti   N R Dhar
S C Chatterjee   R B Lal
S P Chatterjee   A C Joshi
N N Dasgupta   S L Hora
G J Fowler   N R Sen
S S Bhatnagar   Samar Sen
P C Mahanti   H P Maity
S C Mitra   B Mukerji
J N Mukherjee   S R Palit
Kamalesh Ray   N C Saha
B B Sarkar   J M S
S K Ghaswala   P K Sen
V Subrahmanyan   S N Sen
S Hedayetullah   S C Sirkar
S S Sokhey   J N Bhar
Manek B Pithawalla
K P Chattopadhyay
S P Ray Chaudhury
H K Mookherjee
Surendra Nath Sen

Editorial & Publication Offices
92 Upper Circular Road
Calcutta 9

Advertisement Office
92 Upper Circular Road
Calcutta 9

VOL. 15 AUGUST 1949 No. 2

FOOD AND CASH CROPS CRISIS IN INDIA.......... ....
Need of Industrialization of Principal Commercial Crops of India—
J. C Saha ....
Organization of Scientific Research in France—*S N Sen*,............ ....
Marine Algae and Food Problem—*Kalipada Biswas*. ....
Some Aspects of Study in the Life History of Insects—*G. A. Patel, R R. Savoor & A C Basu* ....
Theories and Operation Characteristics of Lead
V L N Rau ....
Impressions of India—*Albert F Blakeslee*.......
The Council of Scientific and Industrial Rese
NOTES AND NEWS................. ....

LETTERS TO THE EDITOR

The Limits of Upper Khirthar in the Indian Region—*H. S. Puri*.....
Sulphanilybenzamide and its N⁴-Substituted Derivatives—
R Bhattacharya & U P. Basu.. . ...
On the Food and Feeding Habits of the Leopard Pomphret, *Scatophagus Argus* (Pallas) and the Possibility of its Culture near the Estuaries of Bengal —*H K Mookerjee, D N Ganguly & T. C. Mazumdar*................ ....
The Effect of Hail Storm on three Crop Pests—*D V. Murthy, A. S. Rao & Md. Qadiruddin Khan*........ . .. .
Datura Metel Again—*D. Chatterjee*..... . ...
A Preliminary Note on the Use of the Male Toad *Bufo Melanostictus* Schneid, as a Test Animal for Bovine Pregnancy—*J. L. Bhaduri & N. R. Bardhan*.. ... .
A Note on Stratus Cloud over Jodhpur—*Khan M. Shamshad*...............
Disease and Disorders in some Indian Tobaccos—*G. C. Das Gupta*.... ....
BOOK REVIEWS......... ... .

36555
IARI

The annual subscription to the journal is Rs 10/ (inland) [illegible] Ordinary Membership fee for the Association is Rs 15/ (£1 10 or $7.00) per year wh the subscription of the journal A person or a Corporation paying Rs 150/ (£12 or shall be eligible for a Life Membership of the Association and will be entitled to a c journal every month

The Indian Science News Association and the Editors of SCIENCE AND CULTURE no responsibility for statements and opinions advanced by contributors to this J

All MANUSCRIPTS should be legible and typewritten The Editors reserve to the right to accept or reject the whole or portions of the matter sent for publi rejected contributions are not returned to authors if postage is not prepaid

Remittances for membership dues subscription and advertisement costs addressed to the TREASURER, INDIAN SCIENCE NEWS ASSOCIATION at 92 Upp Road, Calcutta, 9

Editorial communications are to be addressed to the Editor and other comm to the Secretary, Indian Science News Association both at 92, Upper Circular Road,

LET US HELP YOU

IN OBTAINING

ALL YOUR LABORATORY EQUIPMENT

WE SPECIALISE IN

SCIENTIFIC APPARATUS

OF ALL KINDS

ALSO

ACIDS, SOLVENTS & OTHER
CHEMICALS OF REAGENT QUALITY

OUR PATRONS INCLUDE
REPUTED TECHNICIANS IN
VARIOUS INSTITUTIONS AND
INDUSTRIAL CONCERNS
THROUGHOUT THE COUNTRY

ENQUIRIES RESPECTFULLY SOLICITED

Bengal Chemical

& PHARMACEUTICAL WORKS LTD.

94, CHITTARANJAN AVENUE, CALCUTTA 12.

SCIENCE And CULTURE

VOL. 15 SEPTEMBER 1949 No. 3

Published by the
INDIAN SCIENCE
NEWS ASSOCIATION

Editors
M N. Saha
D M Bose S K Mitra
A. C. Ukil P Ray

Associate Editors
A K Ghosh
R Chatterjee B Mukherjee

Collaborators
S P Agharkar Atmaram
Basir Ahmad K G Bagchi
A. C Banerjee K Banerjee
S K Banerjee K P Basu
D. N. Wadia K V Giri
H P. Bhaumik K Biswas
G S Bose N K Bose
D Chakravarti N. R Dhar
S. C Chatterjee R B Lal
S P. Chatterjee A C Joshi
N. N. Dasgupta S I Hora
G J. Fowler N. R. Sen
S S Bhatnagar Samar Sen
P C Mahanti H P Maity
S C Mitra B Mukerji
J N Mukherjee S R Palit
Kamalesh Ray * N. C Saha
B B Sarkar J M Sen
S. K Ghaswala P K Sen
V. Subrahmanyan S. N Sen
S. Hedayetullah S. C Sirkar
S. S Sokhey J N Bhar
Maneck B Pithawalla
P. Chattopadhyay
S. P Ray Chaudhury
H K. Mookherjee
Surendra Nath Sen

Editorial & Publication Offices
92, Upper Circular Road,
Calcutta 9.

Advertising Office
92, Upper Circular Road,
Calcutta 9

SECOND ANNIVERSARY OF INDEPENDENCE. 85
Organization of Scientific Research in France—*S. N. Sen*............. 87
Place of Pure Science in Engineering and Industry—*Prem Saran Nigam* 94
Salt Toxicity and Plant Growth—
K. N Lal and A. S. Sreenivasamurthy.......... 97
Measurement of Shear Strength of Soil—*S P Baidya*.. 102
Biological Effects of Methoxone on Water Hyacinth—
Ubala Tin, Parukutty Baruah & H K Baruah. 106
Geological Survey of India—*A. K. G* 109
NOTES AND NEWS...,......... 110
LETTERS TO THE EDITOR
On the Affinities of Moringaceae—
R. M Datta, J N. Mitra and D. Chatterjee 115
Beat-Theory of Periodic Fading of Short-wave Radio Signals due to Doppler Effect in Moving Ionospheric Layers—
S R Khastgir .. .. [illegible]6
Vertical Distribution of Atmospheric Ozone in Low Latitudes—
S. L Malurkar....... 118
Notes on *Hilsa Kanagurta* (Bleeker) and *Hilsa Toli* (Cuv. & Val.)—
P. I Chacko & B Krishnamurthi... 11
On the Latitudinal Oscillation of a Quasi-stationary Barometric Trough and the Associated Weather—*K R. Saha*.. 11
The Androecium in Cucurbitaceae—*H L Chakravarty*.. .... 12.
BOOK REVIEWS 122

The annual subscription to the journal is Rs 10 (inland), £1 or $4.00 (Foreign) O nary Membership fee for the Association is Rs 15 (£1 10s or $5.00) per year which c the subscription of the journal A person or a Corporation paying Rs 150 (£12 or $48 shall be eligible for a Life Membership of the Association and will be entitled to a copy of th journal every month.

The Indian Science News Association and the Editors of "SCIENCE AND CULTURE" assum no responsibility for statements and opinions advanced by contributors to this Journal.

All MANUSCRIPTS should be legible and typewritten. The Editors reserve to themselve the right to accept or reject the whole or portions of the matter sent for publication. Th rejected contributions are not returned to authors, if postage is not prepaid

Remittances for membership dues subscription and advertisement costs should b addressed to the TREASURER, INDIAN SCIENCE NEWS ASSOCIATION at 92 Upper Circula Road, Calcutta, 9

Editorial communications are to be addressed to the Editor and other communication to the Secretary, Indian Science News Association, both at 92 Upper Circular Road, Calcutta

LET US HELP YOU

IN OBTAINING

ALL YOUR LABORATORY EQUIPMENT

WE SPECIALISE IN

SCIENTIFIC APPARATUS

OF ALL KINDS

ALSO

ACIDS SOLVENTS & OTHER
CHEMICALS OF REAGENT QUALITY

OUR PATRONS INCLUDE
REPUTED TECHNICIANS IN
VARIOUS INSTITUTIONS AND
INDUSTRIAL CONCERNS
THROUGHOUT THE COUNTRY

ENQUIRIES RESPECTFULLY SOLICITED

Bengal Chemical

& PHARMACEUTICAL WORKS LTD.

94 CHITTARANJAN AVENUE CALCUTTA 12

SCIENCE AND CULTURE

A Monthly Journal of Natural and Cultural Sciences

Published by the
INDIAN SCIENCE
NEWS ASSOCIATION

Editors
D M Bose
S K Mitra   A C Ukil
P Ray   S N Sen

Associate Editors
A K Ghosh
R Chatterjee   B Mukherjee

Collaborators
S P Agharkar   Atmaram
G C Mitra   K G Bagchi
A C Banerjee   K Banerjee
S K Banerjee   K P Basu
D N Wadia   K V Giri
H P Bhaumik   K Biswas
N N Chatterjee   N K Bose
D Chakravarti   N R Dhar
S C Chatterjee   J C Saha
S P Chatterjee   A C Joshi
N N Dasgupta   S L Hora
G J Fowler   N R Sen
S S Bhatnagar   H P Maity
P C Mahanti   B Mukerji
S C Mitra   S R [illegible]
J N Mukherjee   [illegible]
Kamalesh R[illegible]
S K [illegible]
[illegible]   K N Sen
[illegible]   S. C Sirkar
[illegible]   J N Bhar
Maneck B Pithawalla
K. P Chattopadhyay
S P Ray Chaudhury
H K Mookherjee
Surendra Nath Sen

Editorial & Publication Offices
92, Upper Circular Road
Calcutta 9.

Advertising Office
92, Upper Circular Road,
Calcutta 9.

VOL. 15   NOVEMBER 1949   No 5

UN AND WORLD PEACE 167

Polymerization in Suspension—*W P Hohenstein and Shanti Lal Kapur* 171

Fisheries Resources of Western Bengal and their Utilization—*Sunder Lal Hora* 176

Early History of the Botanic Garden Bangalore—*M H Mari Gouda* 181

Physical Ecology and Forest Distribution—*G S Puri* 183

Development of Internal Combustion Engines in India—*P Srinivasan* 186

NOTES AND NEWS 193

LETTERS TO THE EDITOR

Sugarcane (*Saccharum Officinarum L*) Tops as feed for cattle—*N D Kehar & B Sahai* 198

Phyllody in (*Bothriochium virginicum* SW—*H C Govind and H S Narayana* 199

Probability Distribution of Points on a Line—*P V Krishna Iyer & B V Sukhatme* 200

Metallic Complexes of Tartaric and Citric Acids—*R N Sen Sarma* 200

The Ferric Thiocyanate paradox—*Kumar Krishna Chatterji* 201

Studies in Indian Turpentine Production *p* Cymene (3)—*H K Sondhi* 202

BOOK REVIEWS 203

The annual subscription to the journal is Rs 10/ (inland) £ 1 or $4 00 (Foreign) Ordinary Membership fee for the Association is Rs 15/ (£ 1 10s or $ 5 00) per year which covers the subscription of the journal A person or a Corporation paying Rs 150/ (£ 12 or $ 48 00) shall be eligible for a Life Membership of the Association and will be entitled to a copy of the journal every month

The Indian Science News Association and the Editors of SCIENCE AND CULTURE assume no responsibility for statements and opinions advanced by contributors to this Journal

All MANUSCRIPTS should be legible and typewritten The Editors reserve to themselves the right to accept or reject the whole or portions of the matter sent for publication The rejected contributions are not returned to authors if postage is not prepaid

Remittances for membership dues subscription and advertisement costs should be addressed to the TREASURER INDIAN SCIENCE NEWS ASSOCIATION at 92 Upper Circular Road Calcutta 9

Editorial communications are to be addressed to the Editor and other communications to the Secretary Indian Science News Association, both at 92 Upper Circular Road, Calcutta

LET US HELP YOU

IN OBTAINING

ALL YOUR LABORATORY EQUIPMENT

WE SPECIALISE IN

SCIENTIFIC APPARATUS

OF ALL KINDS

ALSO

ACIDS, SOLVENTS & OTHER
CHEMICALS OF REAGENT QUALITY

OUR PATRONS INCLUDE
REPUTED TECHNICIANS IN
VARIOUS INSTITUTIONS AND
INDUSTRIAL CONCERNS
THROUGHOUT THE COUNTRY

ENQUIRIES RESPECTFULLY SOLICITED

Bengal Chemical

& PHARMACEUTICAL WORKS LTD.

94, CHITTARANJAN AVENUE, CALCUTTA 12.

VOL. 15 FEBRUARY 1950 No 8

The Preamble to the Constitution of the Republic of India 291
PLANNING AGAIN 292
Speculative Philosophy or Progress—*Arthur L Morgan* 296
Oil Prospecting in the Inu Hills Area Upper Assam—*J Coates* 302
Recent Advantages in the Knowledge of Cellulose Part II
Modified Varieties of Cellulose—*M K Sen* 304
Economic Use of Coal by Indian Railways—*D Pramanik* 309
Incidence of Cholera in Calcutta and its Dependence on
Seasonal Factors —*Mahabir Ray* 311
Artificial Radioactivity and its Applications—*Irene Curie* 313
NOTES AND NEWS 315
LETTERS TO THE EDITOR
Propagation of *Pan* (*Piper Betle* L) in the Northern
Districts of the Central Provinces—*K A Mahmud* 324
Internal Resistance of an Accumulator—*N C Saha & K P A Menon* 325
Titration Curves of Amberlites I R 100 & I R 4 B—*S L Gupta* 325
The Limits of the Upper Khirthar in the Indian
Region—*Y Nagappa* 326
Buffering of Media for Tetanus Toxin *Anantalal Misra* 327
A Note on a Simplified Technique for obtaining Lapse Rate in Cumulus
Cell when Environment Air is entrained *S N Ray Choudhuri* 327
On the Occurrence of Velamen in *Eulophia* R BR—*S Lakshminarayana*
and *V Venkatesuarlu* 327
Hygroscopicity of Jute Fibre *P B Sarkar and A K Mazumder* 328
Chemical Investigation of the Bark of *Prunus Nepalensis*
—*D Chakravarti and S A Momen* 329
A Note on the Differential Equation of the Clusius Column for
Separation of Isotopes—*Sudhansu Datta Majumdar* 329
The Constituents of *Coptis Teeta* Wall—*A Chatterjee* 330
Microfossils from the Vindhyans—*A K Ghosh and A Bose* 330
BOOK REVIEWS 331
INDIAN SCIENCE CONGRESS SUPPLEMENT
General President's Address foll P 332

The annual subscription to the journal is Rs 10/ (inland) £ 1 or $4 00 (Foreign) Ordinary Membership fee for the Association is Rs 15/ (£ 1 10s or $ 5 00) per year which covers the subscription of the journal A person or a Corporation paying Rs 150/ (£ 12 or $ 48 00) shall be eligible for a Life Membership of the Association and will be entitled to a copy of the journal every month

The Indian Science News Association and the Editors of SCIENCE AND CULTURE assume no responsibility for statements and opinions advanced by contributors to this Journal

All MANUSCRIPTS should be legible and typewritten The Editors reserve to themselves the right to accept or reject the whole or portions of the matter sent for publication The rejected contributions are not returned to authors, if postage is not prepaid

Remittances for membership dues subscription and advertisement costs should be addressed to the TREASURER, INDIAN SCIENCE NEWS ASSOCIATION, at 92, Upper Circular Road, Calcutta, 9

Editorial communications are to be addressed to the Editor and other communications to the Secretary, Indian Science News Association, both at 92,Upper Circular Road, Calcutta, 9

SCIENCE AND CULTURE

A Monthly Journal of Natural and Cultural Sciences

Published by the
INDIAN SCIENCE
NEWS ASSOCIATION

Editors
D M Bose
S K Mitra A C Ukil
P Ray S N Sen

Associate Editors
A K Ghosh
R Chatterjee B Mukherjee

Collaborators
S P Agharkar Atmaram
G C Mitra K G Bagchi
A C Banerjee K Banerjee
S K Banerjee K P Basu
D. N Wadia K V Giri
H P Bhaumik K Biswas
N N Chatterjee N K. Bose
D Chakravarti N R Dhar
S C Chatterjee J C Saha
S P Chatterjee A C Joshi
N. N Dasgupta S L Hora
G J Fowler N R Sen
S S Bhatnagar H P Maity
P C Mahanti B Mukerji
S. C Mitra S R Palit
J N Mukherjee N C Saha
Kamalesh Ray B B Sarkar
S K Ghaswala J M. Sen
V Subrahmanyan S N Sen
B C Kundu S C Sirkar
S S Sokhey J N Bhar
Maneck B Pithawalla
K P Chattopadhyay
S. P Ray Chaudhury
H K Mookherjee
Satyendra Nath Sen

Editorial & Publishing Office
92, Upper Circular Road,
Calcutta 9.

Advertising Office
92, Upper Circular Road,
Calcutta 9.

LET US HELP YOU

IN OBTAINING

ALL YOUR LABORATORY EQUIPMENT

WE SPECIALISE IN

SCIENTIFIC APPARATUS

OF ALL KINDS

ALSO

ACIDS, SOLVENTS & OTHER
CHEMICALS OF REAGENT QUALITY

OUR PATRONS INCLUDE
REPUTED TECHNICIANS IN
VARIOUS INSTITUTIONS AND
INDUSTRIAL CONCERNS
THROUGHOUT THE COUNTRY

ENQUIRIES RESPECTFULLY SOLICITED

Bengal Chemical

& PHARMACEUTICAL WORKS LTD.

94, CHITTARANJAN AVENUE, CALCUTTA 12.

Vol. 15 MARCH 1950 No. 9

HOLIDAYS AND VACATIONS.. 333
Road Planning for West Bengal—*T. Mitra*.. 336
Cinchona finds a New Home—*R. Chatterjee*...................................... 339
The Concept of Engineering Neurology—*S. K. Gharuvala*..................... 342
A Preliminary Account of a Geographical Expedition to the Central Himalayas—*H. L. Chibber*.. 344
The Hydrogen Bomb—*B. D. Nag and Santimay Chatterjee*.. 345
NOTES AND NEWS......................... 349
LETTERS TO THE EDITOR
A New-Formula for Estimation of Laef Area in Barley —*K. N. Lal and M. S Subba Rao.* 355
Pleochroic Haloes in Indian Minerals—*M. S. Doraiswami.* 357
Vein-Splitting, a Boron Deficiency Disease of Citrus in Assam—*S. Chowdhury and S. Dutt*...... 358
Vertical Distribution of Atmospheric Ozone in Low Latitudes—*K. R. Ramanathan and R. V. Karandikar and S L. Malurkar*... 359
Manufacture of Vitaminised *Daler Badi* (little balls of split pulses) and its Nutritional and Economic Significance—*Hara Gopal Biswas* 360
Ionic Antagonism in Cation Exchange Reaction—I —*Shankarananda Mookerjee*... 361
Vivipary in *Artocarpus Integrifolia* Linn—*V Venkateswarlu and J. L. Kanta Rao*... 362
Wheat Rusts from Madras—*T. S. Ramkrishnan*...... 362
On the Role of Cellulose in Filter Paper Chramatography —*D. P. Burma and B. Banerjee*.................. 363
A New Fixative for Differential Staining of Pollen Grains—III —*N. K. Tiwary and Shankerji Shrivastava*.............. 364
BOOK REVIEWS 364
SCIENCE CONGRESS SUPPLEMENT:
Addresses of the Sectional Presidents (Summaries)...... ....foll. P. 364

The annual subscription to the journal is Rs. 10/- (inland), £ 1 or $4 00 (Foreign) Ordinary *Membership fee for the Association is Rs. 15/- (£ 1. 10s. or $ 5 00)* per year which covers the subscription of the journal A person or a Corporation paying Rs. 150/- (£ 12 or $ 48.00) shall be eligible for a Life Membership of the Association and will be entitled to a copy of the journal every month.

The Indian Science News Association and the Editors of "SCIENCE AND CULTURE" assume no responsibility for statements and opinions advanced by contributors to this Journal

All MANUSCRIPTS should be legible and typewritten. The Editors reserve to themselves *the right to accept or reject the whole or portions of* the matter sent for publication. The rejected contributions are not returned to authors, if postage is not prepaid.

Remittances for membership dues, subscription and advertisement costs should be addressed to the TREASURER, INDIAN SCIENCE NEWS ASSOCIATION, at 92, Upper Circular Road, Calcutta, 9.

Editorial communications are to be addressed to the Editor and other communications to the Secretary, Indian Science News Association, both at 92,Upper Circular Road, Calcutta, 9

SCIENCE AND CULTURE

A Monthly Journal of Natural and Cultural Sciences

Published by the
INDIAN SCIENCE
NEWS ASSOCIATION

Editors:
D. M. Bose
S. K. Mitra A. C. Ukil
P. Ray S. N. Sen

Associate Editors
A. K. Ghosh
R. Chatterjee B. Mukherjee

Collaborators
S. P. Agharkar Atmaram
G. C. Mitra K. G. Bagchi
A. C. Banerjee K. Banerjee
S. K. Banerjee K. P. Basu
D. N. Wadia K. V. Giri
H. P. Bhaumik K. Biswas
N. N. Chatterjee N. K. Bose
D. Chakravarti N. R. Dhar
S. C. Chatterjee J. C. Saha
S. P. Chatterjee A. C. Joshi
N. N. Dasgupta S. L. Hora
G. J. Fowler N. R. Sen
S. S. Bhatnagar H. P. Maity
P. C. Mahanti B. Mukerji
S. C. Mitra S. R. Palit
J. N. Mukherjee N. C. Saha
[illegible] Ray B. B. Sarkar
[illegible] J. M. Sen
V. [illegible] [illegible]
[illegible] [illegible]
[illegible] [illegible]
[illegible]
K. P. [illegible]
S. P. Ray Chaudhury
H. K. [illegible]
[illegible]

[illegible]
[illegible] Upper Circular Road,
Calcutta [illegible]

[illegible]
[illegible] Upper Circular Road,
[illegible]

LET US HELP YOU

IN OBTAINING

ALL YOUR LABORATORY EQUIPMENT

WE SPECIALISE IN

SCIENTIFIC APPARATUS

OF ALL KINDS

ALSO

ACIDS, SOLVENTS & OTHER
CHEMICALS OF REAGENT QUALITY

OUR PATRONS INCLUDE
REPUTED TECHNICIANS IN
VARIOUS INSTITUTIONS AND
INDUSTRIAL CONCERNS
THROUGHOUT THE COUNTRY

ENQUIRIES RESPECTFULLY SOLICITED

Bengal Chemical
& PHARMACEUTICAL WORKS LTD.
94, CHITTARANJAN AVENUE, CALCUTTA 12.

VOL. 15 APRIL 1950 No. 10

NEED OF A COMPREHENSIVE PLANNING FOR DEVELOPMENT OF AGRICULTURE IN INDIA 369
Agricultural Extension Service in the United States—*J. C. Saha* 371
Technical Assistance to Under-Dveloped Countries—*J. C. Ghosh* 374
The Soil and the Engineer—*B. Chatterjee* 376
Paper Making in India—*D. C. Tapadar* 379
A Method for Comparing the Relative Quality of Jute Yarns—*K. R. Sen* 384
NOTES AND NEWS 389

LETTERS TO THE EDITOR:

The Tajik-Galcha Origin of Parsis —*Maneck B. Pithawalla & S. F. Desai* 396
Ionic Antagonism in Cation Exchange Reactions—II —*Shankarananda Mukherjee* 397
Colchicine-induced Polyploidy in *Amarantus blitum* —*S. L. Tandon and J. J. Chinoy* 398
Optical Specificity of Protein Hydrolysates—*N. Ray* 399
Double Staining with Aceto-Carmine and other Rapid Techniques—IV —*N. K. Tiwary and Shankarji Shrivastava* 399
A simple Method of obtaining Difference Equations of Probability Generating Functions of Certain Distributions—*P. V. Krishna Iyer* ... 400
Bond Energy and Ionic Nature of Bonds in Polyatomic Molecules —*S. K. Kulkarni Jatkar and (Miss) S. B. Kulkarni* 400
The Food of *Rana Hexadactyla* Lesson, in Relation to Fisheries —*P. I. Chacko and B. Krishnamurthi* 401
Abnormalities in the Flowers of *Vinca Rosea* Linn—*G. A. Kapadia* . 402
Structure of Zingiberene—*S. M. Mukherjee* 403
BOOK REVIEWS 404

The annual subscription to the journal is Rs. 10/- (inland), £ 1 or $4.00 (Foreign). Ordinary Membership fee for the Association is Rs. 15/- (£ 1. 10s. or $ 5.00) per year which covers the subscription of the journal. A person or a Corporation paying Rs. 150/- (£ 12 or $ 48.00) shall be eligible for a Life Membership of the Association and will be entitled to a copy of the journal every month.

The Indian Science News Association and the Editors of "SCIENCE AND CULTURE" assume no responsibility for statements and opinions advanced by contributors to this Journal.

All MANUSCRIPTS should be legible and typewritten. The Editors reserve to themselves the right to accept or reject the whole or portions of the matter sent for publication. The rejected contributions are not returned to authors, if postage is not prepaid.

Remittances for membership dues, subscription and advertisement costs should be addressed to the TREASURER, INDIAN SCIENCE NEWS ASSOCIATION, at 92, Upper Circular Road, Calcutta, 9.

Editorial communications are to be addressed to the Editor and other communications to the Secretary, Indian Science News Association, both at 92, Upper Circular Road, Calcutta, 9

SCIENCE AND CULTURE

A Monthly Journal of Natural and Cultural Sciences

Published by the
INDIAN SCIENCE
NEWS ASSOCIATION

Editors :
D. M. Bose
S. K. Mitra A. C. Ukil
P. Ray S. N. Sen

Associate Editors
A. K. Ghosh
R Chatterjee B Mukherjee

Collaborators
S. P Agharkar Atmaram
G C Mitra K. G. Bagchi
A C Banerjee K. Banerjee
S K Banerjee K P Basu
D. N Wadia K V Giri
H. P. Bhaumik K. Biswas
N. N. Chatterjee N. K. Bose
D. Chakravarti N. R. Dhar
S. C. Chatterjee J C Saha
S. P. Chatterjee A. C. Joshi
N. N. Dasgupta S. L. Hora
G. J. Fowler N. R. Sen
S. S Bhatnagar H. P. Maity
P. C. Mahanti B. Mukerji
S. C. Mitra S. R. Palit
J. N. Mukherjee N. C. Saha
Kamalesh Ray B B Sarkar
S. K. Ghaswala J M. Sen
V. Subrahmanyan S. N. Sen
B. C. Kundu S. C. Sirkar
S. S. Sokhey J. N. Bhar
Maneck B. Pithawalla
K. P. Chattopadhyay
S. P. Ray Chaudhury
H K. Mookherjee
Surendra Nath Sen

Editorial & Publication Offices
92, Upper Circular Road,
Calcutta 9.

Advertising Office
92, Upper Circular Road,
Calcutta 9.

LET US HELP YOU

IN OBTAINING

ALL YOUR LABORATORY EQUIPMENT

WE SPECIALISE IN

SCIENTIFIC APPARATUS

OF ALL KINDS

ALSO

ACIDS, SOLVENTS & OTHER
CHEMICALS OF REAGENT QUALITY

OUR PATRONS INCLUDE
REPUTED TECHNICIANS IN
VARIOUS INSTITUTIONS AND
INDUSTRIAL CONCERNS
THROUGHOUT THE COUNTRY

ENQUIRIES RESPECTFULLY SOLICITED

Bengal Chemical
& PHARMACEUTICAL WORKS LTD.
94, CHITTARANJAN AVENUE, CALCUTTA 12.

SCIENCE AND CULTURE

A Monthly Journal of Natural and Cultural Sciences

Vol. 15 JULY 1949 No. 1

TEACHING OF SCIENCE IN THE INDIAN UNIVERSITIES

NOW that the University Commission is engaged in drawing up their report, it might be helpful in giving a frank expression to our own experience and views on the standard of scientific education imparted in our colleges and universities. Since the transfer of power in 1947, the Indian Government has been faced with a tremendous task of raising an army of properly equipped scientific personnel to meet the requirements of its administration, defence, industry, and agriculture, as well as of its various development schemes. To cope with this the Government sent quite a large number of science graduates with the highest university degree (M Sc) to U K and U S A. for specialized training. The result has, however, been far from encouraging, if not altogether disappointing, in consideration of the expenses involved. Various reasons have been attributed to this poor result, all of which might be partially corrrect. It is said that in some cases the basic training of the finished products of our universities was found to be quite inadequate to profit by the advanced training abroad, in other cases it has been reported that no real provision for specialized and practical training was made for these overseas scholars, and they had to come back with mere academic research degrees. This proves, if any proof be necessary, that facilities for proper and efficient training in science have to be provided in the colleges and universities in India itself, if we want to realize our objective. Appreciating the situation the Government has been very much alive on this matter and has already been making generous grant for teaching and research to our universities, colleges and research institutions.

Money is undoubtedly necessary for the construction of up-to-date laboratories, for their proper equipment, for provision of decent salaries for the staff, and for meeting the running expenses of the institutions. The question is how to ensure their proper and effective utilization, how to make our universities, institutions and colleges effective centres of research and nursery of good and inspiring teachers. For, after all, every body will agree that good teachers are more effective than good buildings and good equipment in producing good students. It will also be agreed to that earlier in the course, the student comes into contact with high quality teaching from inspiring teachers of creative gift, the better it is for him. The problem, therefore, boils it down to the production of good students or good teachers, which means the same thing. For, students of today become teachers and workers of tomorrow. We can now pertinently enquire how far our universities and institutions are fulfilling this function of producing good students. The answer is not far to seek. If we examine the original scientific contributions made by the teachers and workers in India, we are convinced of the fact that India lags far behind in this respect even the small European countries like Switzerland, Holland or Denmark, both in quality and quantity of its products. A cursory glance at the issues of scientific journals of the various learned societies in India and of those of the above mentioned countries is bound to damp the enthusiasm of even the most robust optimist amongst us. It may be argued that India has nevertheless produced a dozen, or more, scientists of international reputation within the last 30-40 years. This cannot meet our arguments at all. A country's achievement is judged by the quality of its average and not by that of a few eminent personalities. Intellects of exceptional brilliance are known to flourish even under the most adverse circumstances. Favourable and congenial atmosphere may help in their early development, but they are not strictly speaking the product of our educational system. Had they been so, then each of them would have been able to produce a school of their own, from which an uninterrupted flow of gifted workers and teachers would enrich our universities and institutions; and there would have been no dearth of trained scientific personnel or teachers in the country today. We think there will not be much opposition to the statement that even these few eminent scientists have not been able in most cases, for some reasons or other, to inspire the young minds by coming in direct personal contact with them either in the lecture rooms or in the laboratories. In the first place, many of them never had the opportunities of teaching the undergraduates with most impressionable mind, and even in the post-graduate classes they found little time to participate in teaching work. At the present time, most of the teachers or workers of repute in India are saddled with administrative duties too early in life, or they are lured away from educational institutions to serve on commissions, committees, delegations, etc They have thus not been able to give that service to the country which they are most fitted for.

This is rather an unhappy aspect of the picture But the most vital aspect relates to the structure of our educational system itself, All education, scientific, technical or otherwise, has been developed in every country through three closely related successive stages, *viz*, through schools, colleges and universities. The education in schools forms the broad basis; here the minds of the students have to be be moulded in their formative period, and the need and constant guidance of good and inspiring teachers in this stage cannot be too strongly emphasized. Schools feed the colleges where the students further improve their intellectual equipment. Need of good teachers and their active guidance are also of equal importance in this stage. In the post-graduate classes of the universities the students are finally equipped to become teachers, research workers and for other careers. It, therefore, follows that to turn out good products from the universities, to meet our national requirements for good and efficient teachers, technicians, researchers and specialists, an uninterrupted flow of good students from the colleges must be maintained, which becomes possible when the colleges too are sustained by a similar flow of properly trained students from the schools All attempts to build up good universities, leaving the schools and colleges ill-managed and ill-equipped, are bound to defeat the very purpose aimed at. For nobody has yet been able to build a pyramid upon an apex Conditions of schools and colleges in India today, which are overcrowded like so many market places and which the students enter and leave like passengers of a crowded train, are too well-known to need any description here. They are run mostly on commercial basis on a mass scale with ill-equipped laboratories, by ineffective and ill-paid teachers catering to an unwieldy and indisciplined horde of youngsters, bent only on securing easy passes for examination There is no wonder, therefore, that the schools and colleges in India today, instead of being the centres for intellectual and cultural training for the young, serve more or less as a recruiting ground for a variety of wholesome and unwholesome political ideologies, unfortunately to a large extent of the latter type with their passionate and sentimental appeals to the immature minds.

In some of the colleges in Calcutta, it has come to our notice that classes are held in three shifts as in a factory, morning, noon and evening Number of students in each class often exceeds 200-250 and the total number of students in some of these colleges reaches up to 10-12 thousands. Can there be any atmosphere of learning under such conditions? Can there be any give and take of thoughts between the teacher and the taught on such a mass scale? We draw the attention of the University Commission to this state of affairs in our educational system; for, the universities have got to depend on the colleges for their supply of raw materials.

We would now venture to make some suggestions which in our opinion, are likely to eliminate these serious defects in our educational system:

1. The secondary education (The H. E. Schools and the Intermediate Classes) should be removed from the control of the universities and should be placed under a rigid control of a Board who will see that the schools and the Intermediate colleges are adequately and efficiently staffed, properly equipped and liberally financed by the State. Classes should be restricted to not more than 20-25 students.

2. All colleges should be subsidized by the State, so that they may not be tempted to depend upon their fee income Classes should be restricted to 20-25 students only Provision should be made for the employment of high quality teachers on suitable remuneration University Professors of high reputation should be deputed to participate in the teaching work wherever possible In the case of residential universities this may be followed as a rule.

3. Admissions to the colleges and particularly to the post-graduate classes in the universities should be strictly regulated. None but the best students should be permitted to enter the universities This will avoid unnecessary waste of human materials and energy Students of average merit, leaving the schools and Intermediate colleges, should be recruited for other professional careers which do not require advanced knowledge of fundamental sciences.

4. A high standard of examination and passes should be rigidly maintained and must, under no circumstances, be relaxed by rules or by-laws allowing graces, concessions, compensations, etc.

If we want that the products of our university should supply the scientific man-power for various departments of the administration, for defence, industries, agriculture, as well as for all development projects, then the teaching of science in our universities must be broad-based upon a sound scientific training in our schools and colleges. At present we are following a most unscientific method in the teaching of science in our colleges and universities.

Quality of teaching has got to be improved from the undergraduate level upwards; and the formidable obstacle in the beginning to be overcome is the scarcity of good and qualified teachers. Remuneration of teaching profession must be raised on a par with similar appointments in government services or industrial organizations, so that professors and teachers of repute in the universities and colleges may not be compelled by economic pressure to meet the increasing living cost by joining administrations or industries. Then again, distinction and honour attached to the title of Professor should in no way be made inferior to those associated with Director-General, Director, etc. In *the beginning, to meet the dearth of good teachers,* India need not hesitate to employ foreign teachers of international repute for limited periods in her colleges, universities and research institutions. This will be a much more fruitful and much more effective method of developing Indian science than spending large sums of money year after year in inviting foreign scientists during Science Congress sessions for a week or so, or sending a large body of our ill-equipped young men to countries where they rarely receive the proper training aimed at.

Another obstacle to be overcome is inadequate or poor laboratories and equipment in most of our colleges. Some of the colleges have not even the proper gas- or water-supply. This aspect of the problem should be seriously taken into consideration if teaching of science, as advocated and contemplated, is to be extended to the school courses. What is the good of encouraging swollen registration for science courses in the colleges, if no proper facilities for teaching of science be available ? This will end in more harm than good and will create more problems than helping to solve the present ones

We need not enter into a discussion here about the courses of study, curricula or syllabuses for different stages, which certainly require considerable modification and overhauling with a new orientation to research approach even in the college courses The system of examination may likewise need a careful and thorough investigation so that the students may imbibe the principle of scientific method, develop self-reliance and foresight, and not turn out to be mere mechanical workers, who can only execute orders and never initiate.

Our present system of scientific education might have developed the abstract intellect of our young men to a certain extent, but it has failed to make them intelligent citizens It has created merely a hastiness of opinion in them to which they often cling more or less with a fanatical finality without conceding that it may be wrong To have any real value, scientific method has to be taught and learnt not as a mere abstraction like the solution of a mathematical problem, but as something which has to be lived and applied in practical life If our schools, colleges and universities be properly developed for training in science and scientific method, if they be properly manned and intelligently directed to the reconstruction of human character, then there is little doubt that they will serve as open sesame to peace, prosperity and happiness of our country. For, all our plans and schemes for development need men of ability and character to work them out.

P. R.

FOOD AND PEOPLE

S N SEN

UNITED NATIONS' EDUCATIONAL, SCIENTIFIC AND CULTURAL ORGANIZATION, PARIS

Problems of Food and Population

THE world population is increasing at an alarming rate But the food supplies are not increasing rapidly enough to avoid the gloomy prospect of a serious food shortage in the near future Naturally enough, thoughtful men and women all over the world are deeply concerned today with the embarrassing problem of balancing population and food supply.

About one hundred years ago, the world's population was 1,091,000,000, today it is 2,250,000,000, that is, the population doubled in the course of a century. If the present rate of increase, of 20 million a year, continues—and it is unlikely that this trend will be otherwise in the foreseeable future—the population will again double in another century

On the other hand, the world's total land area is estimated at 13,550 million hectares, of which about 2,090 million hectares are arable. Not all of this is being cultivated and not all is cultivable under present conditions A substantial increase in the cultivable area for food production might be expected, but meanwhile precious soil is being speedily lost for ever through natural as well as man-made erosion. Our food situation is bad enough already, about two-thirds of the human race are now condemned to a bare subsistence level, let alone living on a nutritionally adequate diet. Can we hope to feed the growing population indefinitely from the more or less constant agricultural resources? These are some of the rude facts which lie at the bottom of our present fears and anxieties.

Fears that the population might outrun the means of subsistence are not new. Towards the end of the XVIIIth century, Malthus, in his "Essay on the Principles of Population," gave a very forceful expression to these fears and came to the pessimistic conclusion that food supply would always tend to fall short of the population and that hunger, famine and pestilence would always be active in restoring the balance between food and population. It is well known that Malthus' views dominated thought in Europe and elsewhere for a long time.

The problem of balancing population and food is very grave indeed; but it is not hopeless or insoluble, experts of unimpeachable knowledge point out. After all, Malthus' fears did not come true in the nineteenth century. On the contrary, mankind entered a period of plenty and prosperity. This was so on account of the phenomenal development in science and technology, invention of machinery, development of transportation, etc., which revolutionized agricultural practices and distribution of agricultural products. The opening of new lands for settlement in the Americas, Australia, and elsewhere also played a very significant part in absorbing surplus population from the crowded old world.

Today, it is true, there are no more new continents to be settled, no new "open spaces" to be filled in. But our stock of scientific knowledge is incomparably greater than at the beginning of the nineteenth century. Agriculture in most parts of the world is still primitive, loss of fertile land through erosion is still appalling, and about 65,000,000 tons of grain are still destroyed annually by mites, pests and rodents. In those parts of the world where science has been most extensively applied to agricultural practices, there have been significant *increases* in production without corresponding increases in the land under cultivation, soil erosion has been checked, and insect pests controlled. Granted favourable economic, political, and sociological conditions, the results which have been achieved through the application of science in one country can be repeated in every other country of the world. If this is done, there is every reason to hope for a doubling or trebling of our food production within a relatively short time. But only if?

What can Unesco do ?

However, stripped of all details, statistics, tables and charts, this is briefly the problem raised by "Food and People," which the Director-General of Unesco has recommended to the Member States as a subject for widespread discussions and debates this year. The practical task of advising the governments as to the best ways and means of developing the food and agricultural resources belongs to the Food and Agriculture Organisation of the United Nations. Likewise, the Population Division of the UN is worrying about the world population problems. In what way can Unseco contribute to the food and population problems of the world ?

People must know the problems of Food and Population

Through education. Action is easier when knowledge is accurate and universal. The success of governmental or inter-governmental measures is more and more dependent on the extent of public enlightenment on the problems and issues concerned. No plan or scheme, however perfect and grandiose, can work today in the vacuum of public ignorance. By initiating debates and discussions on "Food and People" at all levels, academic, popular, and semi-popular, all over the world, Unesco hopes to contribute to the creation of an educated and informed public, which will be of great help to other specialized agencies directly concerned with the problems of food and population.

People must realise how much society owes to science

There is yet another very important reason for choosing "Food and People" as a discussion subject. This is to create a more widespread awareness of the social and international implications of science. The rapid increase in population during the last century is primarily due to the industrial and agricultural revolution brought about by the development of science and technology. Moreover, the problem of balancing population and food supplies may be full of controversy, but there is no disagreement on the final issue, namely, that the world's food problems cannot be solved except by intensive application of science and technology to all aspects of agriculture. Furthermore, international co-operation is indispensable if we are to make any effective use of science to this end. The discussions would provide an excellent opportunity to show how inseparably the future welfare of mankind is linked with the peaceful development of science.

How does Unesco propose to do it ?

Unesco is anxious to encourage these discussions among all groups of men and women and at all levels. On the one hand, scientists, economists, sociologists, population and food specialists, and members of other disciplines must meet to exchange their views; on the other, the discussions must be open to the public at large, through students' organisations, adult education bodies, workers' education groups, army education centres, and finally, through mass media like the press, radio, and film.

A number of specialists of international fame, from twelve nations, will contribute to the discussions by preparing background pamphlets on various aspects of food and population, such as the "Double Crisis" and "The Way Out," scientific advances in agriculture, problems of soil, forests and water; development and distribution of the world's resources, food and nutrition, family and food habits, child nutrition; fisheries; facts and prospects of population, population problems of India and China, population movements, fundamental education and natural resources; international co-operation, etc.[1] The pamphlets will be made available in English, French and Spanish, for wide distribution. The series has been planned in close co-operation with the United Nations and some of its specialized agencies.

Further interest in the subject will be stimulated through a series of radio broadcasts, films, press articles, wall charts, photo exhibits, and other instruments of mass communication It is a long and difficult task, but Unesco is confident the people will do it

---

[1] Background Pamphlets on FOOD & PEOPLE
A Over-all master pamphlet on Food and People Mr Aldous Huxley (U K) and Sir John Russell (U K)
B. Background pamphlets for popular level discussions
  1. Population – Facts and Prospects Mrs. A Myrdal (Sweden) and Dr Paul Vincent (France)
  2 Food --Facts and *Prospects* -Dr C E Kellogg (U S A)
C. Background pamphlets for semi-popular levels
  1 *Fundamental Education and Natural Resources* Dr Nannetti (Colombia)
  2 Family and Food Habits Mrs Margaret Mead (U S A)
  3 *International Co-operation Mr Peter Kihss* (U S A)
  4 Child Nutrition—Mrs Martha Eliot (U S A)
D Background pamphlets for academic levels
  1. Science, Technology & Population – Dr Warren S Thompson (U S A)
  2 Balance and Movements of Population, including two papers :
    (a) Areas of Rapid Population Growth—Dr Kingsley Davis (U S A)
    (b) Movements of Population—Dr Julius Isaac (U K)
  3 Population Problems of China Dr Ta Chen (China)
  4 Population Problems of India - Dr S Chandrasekhar (India)
  5. Genetics, Food and People Prof C H Waddington (U K)
  6 Food and Nutrition, including four papers
    (a) Introduction -Food and Welfare -Dr Andre Mayor (France)
    (b) Nutritional Problems of South America Dr Josue de Castro (Brazil)
    (c) War time Nutritional Experiments in Switzerland –Dr F T Wahlen (Switzerland)
  7 Scientific Advances in Agriculture Dr B A Keen (U K)
  8 Soil, Forests and Water Dr Raymond Furon (France)
  9 *Food from Stream and Sea* Dr H Blegvad (Denmark)
  10 Full Development of the World's Food Resources Dr E de Vries (The Netherlands)
  11 Distribution of the World's Food Dr Stephen Krolikowski (Poland)

THE MANGO AND ITS RELATIVES

SUNILKUMAR MUKHERJEE
BOTANY DEPARTMENT, CALCUTTA UNIVERSITY*

HISTORY

THE mango, one of the most important tropical fruits, has a long early history, as evidenced from its reference in early Sanskrit literature and prominence in Hindu mythology and religious observances, indicating thereby its occurrence in India from very early days DeCandolle[1] considers it probably to be cultivated by man for over 4000 years This interesting fruit tree was always mentioned in the notes of the foreign travellers, who visited India during early days, *e g*, Hwen T'sang (632-645 A.D), Ebn Hankal (902-968), Ebn Batuta (1325-1349), Lurdovici de Varthema (1503-1508) etc From the available records, it appears that Hwen T'sang was the first person to bring mango to the notice of the people of Western Hemisphere

The mango had an important place in horticulture during the rule of Muhammedan emperors in India They promoted the practise of planting these trees in big orchards, with the best selected varieties available Relics of some such big orchards are still found in different parts of India. Most of the improved cultivated varieties of India, had its origin in those early days since when they have been maintained under cultivation for over 400 years by vegetative propagation The *Ain-i-Akbari*, an encyclopædic work written during the reign of Akbar (about 1590 A D.), contains a lengthy account of mango, giving information about the quality of the fruits and other varietal characteristics It appears from the above account that a fairly good knowledge about mango culture, and the characters of the different varieties, was gathered by the people of India during the sixteenth century or even earlier

THE MANGO VARIETIES AND THEIR RELATIVES

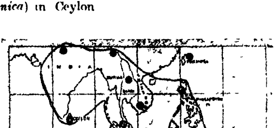
Due to cultivation of the mango for such a long time and selection by man for his own needs, a great range of variation has been produced, as a result of which about a thousand varieties have been evolved in India They are all included in the single species *Mangifera indica* L (Fam Anacardiaceæ) The varieties of mango may be broadly grouped under two categories, *viz* (1) the *seedling races* (both wild and cultivated), and (2) the *horticultural varieties*, propagated by budding or grafting In India, the seedling races, derived mostly from the thrown-out seeds of the grafted varieties, are not much cared for, whereas in other countries of East Asia *e g*, Indo china and the Philippines, they constitute the economic varieties, among which the races *Cambodiana*, *Mekongensis*, and *Carabao* are noteworthy. The 'wild' seedling races, on the other hand, occur almost throughout India, in the tropical and sub-tropical hilly forests at an elevation up to 3,000 ft They are very common in the forests of the Chittagong Hill Tracts (near Burma border) Assam, Chota Nagpur, Eastern States Agency (Orissa), at the base of the Himalayas and in the Western Ghats, where they grow on sloping hill-sides by the ravines and hill-streams and attain an immense height of 100-150 ft. with a straight trunk The fruits of these wild types are usually smaller, but sometimes attain almost the same size as the grafted varieties, under favourable conditions.

---

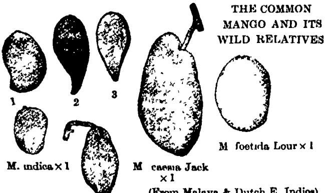
*At present, Assistant Botanist, Indian Sugarcane Breeding Station, Coimbatore, South India.

The horticultural varieties, which produce the best quality fruits, are mostly of Indian origin In comparison to about a thousand varieties occurring in India, those originating in other regions of the world are not more than fifty Burns and Prayag[2] reported the occurrence of about 500 varieties in Bombay Presidency, Naik[3] reported about 350 varieties from Madras, whereas in Bengal, Bihar[14] and U P more than 300 varieties are present It is quite likely that some of these varieties may be the same although occurring under different names in different provinces. In spite of the reduction of these common types, the number of horticultural varieties present in India will be sufficiently high They differ from one another mainly in the shape, size and general features of the fruits, on the basis of which they can be classified under three main groups :—(1) *Round-*, (2) *Ovate-oblong-*, and (3) *Long fruited* Amongst the large number of grafted varieties, about two dozens are of commercial importance, of which the following are worth mentioning.—(a) *Pairie*, *Alphonso*, *Mulgoba*, *Sundershaha*, and *Cowasji-Patel of* Bombay, (b) *Baneshan* or *Banganapalle*, *Kalepad* or *Kallapady*, *Rumani*, *Neelum*, and *Bangalora* or *Totapuri of* Madras, (c) *Langra*, *Bombai*, *Fazli*, *Jardalu*, *Golapkhas*, *Daseri*, *Himsagar*, and *Kalapahar* from Bengal, Bihar and U P

The genus *Mangifera* consists of 41 species, which are distributed throughout Malaysia from India and Ceylon in the west to the Philippines and New Guinea in the east (see map below) Most of them are 'wild' and economically unimportant, except those shown in the table (see next page), some of which are cultivated for their edible fruits Only two species (*M. indica* and *M. sylvatica*) occur in India, and one (*M zeylanica*) in Ceylon



The species under 'Section II' in the table, possess quite big fruits (about 10 cm. long), attaining a length of 20 cm in *M. cæsia*, the size of the fruits being comparable to that of the economic cultivated varieties of the common mango (*M indica* of 'Section I') Consequently *M. cæsia*, *M. odorata* and *M. foetida* are encouraged to be widely cultivated in Malaysian countries. Detailed information about the fruits of the edible species, mentioned above, is given below as it will be found interesting from the horticultural standpoint.



THE COMMON MANGO AND ITS WILD RELATIVES

(From Malaya & Dutch E Indies)

M caesia Jack × 1

1. M indica Linn × 1 (Common mango)

2 & 3 M sylvatica Roxb. (From Assam)

Species of Section II · *M lagenifera* has 10-12 cm. long fruits, with 2 cm. thick purplish-cream coloured flesh, traversed by innumerable fibres Because of the fibre and foetid smell it is not much liked and little eaten *M. macrocarpa* has obliquely oblong globose fruits, of the size of a child's head, with yellow bitter-sweet flesh, which is not relished. *M fœtida* has 8-10 cm. long fruits with 2 cm thick flesh, traversed with many fibres The fruits are much eaten by the Malayanese, because the flesh is sweet when ripe although the flavour is coarse with disagreeable smell *M odorata* has also 10 cm. long fruits, with a distinctive flavour when ripe The flesh is sweet but traversed by coarse fibres. Next to *M. indica*, the fruits of this species are most liked by the people of Malay. Culture may make this a good fruit suitable for this region, where the grafted varieties of mango are not so successful *M caesia* has 18-19 cm long fruits with thick flesh traversed by coarse fibres The flesh is juicy and acidic, but in one race it is sweeter than others Malayanese are fond of the fruit but the smell is certainly very objectionable. *M. verticillata* (a species reported from the Philippines which appear to be a variety of *M cæsia*), is cultivated for its fruits which are superior to those of *M cæsia* *M kemanga* has fruits somewhat similar to *M cæsia* and possess juicy flesh It is also used in curries for its sour flavour. *M. Reba* has 8 cm long fruits, eaten by the people of Indo-china

Species of Section I: Apart from *M. indica* (the common mango) the remaining species of 'Section I' has smaller fruits with very thin flesh. The wild races of M *indica* also bear such small fruits with thin flesh *M. pentandra has* round fruits of good taste. *M. cochinchinensis* has 3 cm. long fruits liked by the

Name of the species of *Mangifera*	CEYLON	INDIA	ANDAMANS	BURMA	SIAM	INDOCHINA	MALAY PENINSULA	SUMATRA	JAVA	BALI	BORNEO	MOLUCCAS	CELEBES	NEW GUINEA	PHILIPPINES
SECTION I.—DISC SWOLLEN—															
5 Stamens fertile.															
1. *M. pentandra* Hook. f.						+	+								
2. *M. cochinchinensis* Engl.						+									
1 Stamen fertile															
*3. *M. indica* Linn.	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
4. *M. sylvatica* Roxb.		+	+	+	+	+									
5. *M. oblongifolia* Hook. f.					+	+	+								
6. *M. zeylanica* Hook. f.	+														
7. *M. altissima* Blanco.															+
SECTION II.—DISC REDUCED OR ABSENT															
5 stamens fertile.															
8. *M. lagenifera* Griff.					+	+	+								
1 Stamen fertile.															
9. *M. macrocarpa* Bl.						+	+		+		+				
*10. *M. foetida* Lour.				+	+	+	+	+	+		+	+	+		+
*11. *M. odorata* Griff.						+	+	+	+		+		+		
12. *M. Kemanga* Bl.							+	+	+						
*13. *M. caesia* Jack.							+	+	+	+	+				+
*14. ,, var. *verticillata* (Roxb.) Mukherji,															+
SPECIES DUBIA.															
15. *M. Reba* Pierre.						+									

* Species widely cultivated.

people of Indo-china, though of inferior quality. *M. sylvatica* has 6-8cm. long fruits with a thin slimy, flesh having a fine aroma. It is almost free from fibres. *M. oblongifolia* has 4 cm. long fruits, which are picked unripe and eaten after cooking in Indochina. *M. zeylanica* has 6 cm. long fruits, almost of the same size and shape as the wild mango (*M. indica*). The flesh is thin, juicy, pleasantly acidic and possessing an agreeable flavour, but traversed by innumerable soft short fibres. *M. altissima* has 5-8 cm long fruits with flesh almost free from fibres. These are used by the Philipinos for pickling.

DISTRIBUTION OF THE MANGO AND THE HISTORY OF ITS INTRODUCTION IN DIFFERENT REGIONS OF THE WORLD

The mango is now distributed throughout the tropics of both the hemispheres. Whether they are indigenous in some of these areas, it is rather difficult to determine from the evidence of their occurrence only in the forests, as it becomes naturalized and takes on the appearance of a wild plant, when introduced into regions where soil and climatic conditions are favourable for their growth.

De Candolle writes —"It is impossible to doubt that it is a native of South Asia or of the Malay Archipelago, when we see the multitude of varieties cultivated in those countries, the number of ancient names, in particular a Sanskrit name, its abundance in the gardens of Bengal, of Dekhan Peninsula, and of Ceylon even in Rheede's time (1683)." The true mango is indicated to be wild throughout the tropical forests of India, especially at the base of the Himalayas in the east, in Arracan, Pegu and the Andamans. Miquel[4] does not mention it as wild in any of the islands of Malay Archipelago. According to Rumphius it had been introduced into certain islands of the Asiatic Archipelago within the memory of living men. Forester does not mention it in his work on the fruits of the Pacific Islands at the time of Cook's expedition.

De Candolle's arguments, the history of the genus, the phytogeographical distribution and other evidences suggest that the mangoes (*Mangifera indica*) have originated somewhere in the Assam-Burma-Siam-Indochinese region, most possibly in the Assam-Burma zone whereform the cultivation of this fruit tree must have spread at an early age over the Indian sub-continent. The improved varieties were subsequently introduced to other regions of the world.

Its Malayan names attest its exotic origin, *Mangga* being the same word as the Tamil *Mangas*, and produce, evidence for the introduction into Malay of the superior races of mango from India[6]. The size of the stone (seed) is too great to allow of its being carried by birds and other animals but the frequency of its cultivation suggests a dispersal by human agency. Its introduction into the islands of the Malay Archipelago and other East Asiatic countries is very likely due to the Indians making voyages to those areas during the Buddhist period (3rd-4th century B.C.). Wester[7] considers that the mango was probably introduced into the Philippines during the first half of the 17th century.

The wider dissemination of the mango throughout the world started with the beginning of commerce between Asia and Europe, as in the case of many other tropical fruits and spices. The Portuguese were the first to come to India, and seized the opportunity of trading in spices and other vegetable products of the East. It is most likely that early in the 16th century they carried the mango, plants and seed, from Goa to East Africa and thence to West Africa and adjacent island possessions and subsequently to Brazil. Capt. Cook found the fruit produced in great abundance at Rio de Janeiro in 1768.

The mango was first introduced at Barbados in the West Indies near about 1742, the tree or its seeds having been brought from Rio de Janeiro. It has become naturalized and is now growing plentifully in every district of Jamaica, after being introduced in 1782, through seeds found on board a French ship captured by a British warship[8]. Mexico has received mangoes from two sources, some from the West Indies early in the 19th century, and others from the Philippines, brought by the Spanish galleons, who traded in early times between Manila and Acapulco. Higgins[9] states that it was probably introduced to Hawaii first from Mexico, but more recent introductions have been from India, the Philippines and Jamaica.

In U. S. A. the earliest introduction appears to have been made in Florida from Mexico in 1833. The second successful introduction was made in the lower east coast of the State at Miami in 1861-62. The grafted Indian varieties were first introduced in 1885 but these plants did not survive. The second introduction was made in 1888 through a shipment of 35 inarched trees from Calcutta.

RESEARCHES ON MANGOES AND THE FUTURE PROBLEMS

The mango is now an important fruit crop of India and some of the Malayan countries. After its introduction in America, it is gaining popularity there and is now found in the markets of Florida and California. Extensive researches are therefore being carried out for the improvement of the crop in India and elsewhere. Apart from the cultural treatments required for increasing their production by improved methods of grafting or budding, by manuring etc., the main problem lies in the regular production of the fruits every year. It is a well-known fact that most of the mango varieties do not bear flowers every year, but once in two or three years, only a few are regular bearers. Sen[10] has investigated into the physiological causes for this phenomenon and found that the deficiency of nutrition in the plant after heavy bearing is the main factor responsible for not producing flowering shoots in the same plants next season. It is obvious that the plant requires some time to regain the nutritional balance sufficient to promote the production of flowers and the growth of the fruits.

Another problem which has attracted sufficient attention is the cause for the development of a very low percentage of mature fruits in comparison to the huge number of flowers produced in a plant. An inflorescence of the mango bears nearly 2,000–6,000 flowers, according to the variety, among which 1.25–35.6% are bisexual and the rest are functionally male. The bisexual flowers 'setting fruits' (i.e. fertilized) varies 13.4–28 4%, most of which drop before reaching maturity. Hence the fruits harvested are mostly between 0 1–1 0% of the bisexual flowers in an inflorescence under the natural conditions. The setting of a fruit depends on the successful fertilization of a flower In order to find out the causes for the drop in the 'fruit-set,' the present writer undertook some experiments to examine if there is any defect in the male or the female gametes (pollen and ovary) which are the fundamental organs for fruit-formation The investigation has shown that the pollen grains are quite normal and healthy, with an apparent sterility ranging between 2—13%, which is negligible in comparison to the huge number of the male flowers produced There is also no defect in the female organ The main factor responsible for such a drop in fruit-set is the failure in transfer of the male gamete, pollen, to the female gamete. From an examination of open flowers in the field, it has been observed that about 66% of the bisexual flowers do not receive any pollen grain This phenomenon was also seen by Naik[11] in India and Bijhouwer[12] in Java The next important factor is the climatic conditions such as rain, dew and sudden lowering of temperature during the flowering season affecting pollen-transference, and its germination on the stigma. After the formation of the fruit (*i e*, fruit-set), the growth of the fruit is dependant on the physiological processes helping in the supply of balanced nutrition to the developing fruit

Apart from the works on the above lines of investigation on the factors helping in the production of a larger number of fruits, some fundamental researches on the cytogenetics of the various mango varieties and the allied species, have recently been conducted at the Calcutta University with a grant-in-aid from the Indian Council of Agricultural Research It has been observed that all the mango varieties investigated, and the allied species *M sylvatica* and *M caloneura* have the same chromosome number $n = 20$, and $2n = 40$ They differ from one another with respect to minute morphological details in the different chromosome complements, *e g*, length of the chromosomes, the number of satellites and secondary constrictions.

A beginning has been made in another line of investigation leading to the production of new varieties by hybridization. Successful intervarietal crosses have been made both in India (by Burns and Prayag, Sen and Naik), and in America The progenies raised by such crossings have not yet been thoroughly studied to give an idea as regards their superiority over the available varieties

From a survey of the knowledge regarding the varieties of mango and the various allied species and the researches undertaken on this important fruit-crop, the following suggestions are indicated :

As there are other species of *Mangifera*, in addition to *M. indica* (the common mango) bearing big edible fruits of inferior quality, attempts should be made to improve some of these types, particularly with a view to grow them in areas, where the best Indian varieties have not proved successful (*e.g.* Florida, Malay etc).

As the cultivated mangoes are polyploid species, so the method of artificial induction of polyploidy is not likely to help in the improvement of the crop. Selection from the best Indian types, which produces, finest fruits in the world, will prove useful.

Due to the similarity in the chromosome number and morphology between the varieties of mango (*M. indica*) and the wild species *M sylvatica* (Indian) and *M. caloneura* (Burmese), it is desirable to utilize them for interspecific hybridization which may combine the useful economic characters A thorough search for the types of *M. indica* which are occurring in various regions of India is desirable.

The future improvement of the mango varieties in India therefore appears to depend on selection, intervarietal and inter-specific hybridization, and on the factors regulating the physiological processes affecting nutrition of the plant as a whole and especially the developing fruits, coupled with the improved cultural methods for cultivation of the plants

REFERENCES

[1] de Candolle, A P —Origin of Cultivated Plants. London 1884

[2] Burns, W & Prayag, S. H —The book of the Mango Bull No. 103, Dept. Agri. Bombay 1921.

[3] Naik, K. C. South Indian Mangoes Bull No 24, Agri. Dept Madras 1941.

[4] Miquel, F. A G.—Flora van Nederlandsche India, i (1), 627-634, 1859

[5] Rumphius, G E.—Herbarium Amboinense, i, 93-99, 1471.

[6] Burkill, I H —A Dictionary of the Economic Products of Malay Peninsula, ii 1401-1406, 1935.

[7] Wester, P. J – The Mango Philip Bur Agric., Bull No. 18, 1-70, 1920

[8] Edwards, B – History of the West Indies, 1793

[9] Higgins, J. E The Mango in Hawaii, Hawaii Agric. Exp. Sta Bull No. 12, 1-32, 1906.

[10] Sen, P K – Annual Report of the Fruit Research Station, Bihar, for the year 1938-39 Patna, 1939

[11] Naik, K C & Mohan Rao—Studies of blossom biology and pollination in mangoes (*Mangifera indica* L). *Ind Jour. Hort*, *1*. 107-119, 1943

[12] Bijhouwer, A. P. C.—Een bijdrage tot de kennis omtrent het blooien en het vruchtdragende vermogen van den Mangga (*Mangifera indica* L) (The flowering & fruiting habits of the mango). Wageningen, 1-196, 17 figures

[13] Sturrock, D.—Notes on the Mango (published in cooperation of the Atkins Inst. of the Arnold Arboretum), 1-117, 1944.

[14] Woodhouse, E J.—The Mangoes of Bhagalpur, *Quart. Jour. Dept. Agr* Bengal, 2, 168, 1909.

CAUSALITY AS A PURE FORM

P. J. CHAUDHURY
VISVA-BHARATI, SANTINIKETAN

WE propose to examine a formulation of causality which, it is held by its authors, can save the law in the face of Heisenberg's principle. Planck[1] and Friend and Fiebleman[2] speak of causality as a logical objective principle that works with absolute accuracy in the conceptual world and that can be verified only approximately in the actual world. The reason is, (they hold), that no particular thing can be an exact copy of the idea of it, no law or function can, by its very nature, be realised precisely in the concrete.

Planck[3] puts it in this way: Since no measurement is absolutely accurate in physics, no law can be exactly verifiable. To keep these laws in the form of exact causal laws, and not of just statistical ones as the indeterminists would like to, the physicist "substitutes a new world in place of that given to us by the senses or by measuring instruments which are used to aid the senses. This other world is the so-called physical world image; it is a merely intellectual structure".[4] In this world-image causality works exactly, for here all the physical magnitudes are exact and well defined. This world-image contains, besides such significant components as mass, position, velocity etc., certain components which have no immediate meaning in the sense world, *e g.*, ether waves, partial oscillations, reference co-ordinates Now, inaccuracy, which is always associated with the verification of any law, is not due to the inaccuracy in the law itself but due to that inherent in the translation of an event from the world of the senses to the world-image and back from the latter to the former. Heisenberg's principle has only taught us that the concept of material point must be given up, instead of it we have to substitute a narrow parcel of waves which obey causal laws. The uncertainty in forecasting events in the world is now seen to be due not to any uncertainty of the causal laws but to that with regard to the connection between the world-image and the world of senses[5] We have now inaccuracy arising from transferring the symbols of the world-image to the sense world and vice versa. For the waves of the quantum mechanists are far removed from the sense world.

Planck's attempt to save causality is worthy of praise. So far as he advocates generally the view that every law is ideally true and cannot be accurately verified, he has our support. For a causal law shows a necessary connection between two specifically chosen qualities or states, and to demonstrate it we need always an isolated system where these states are not affected by external and incidental causes. Thus, a controlled experiment is necessary. Now, it is natural that such an isolated system cannot be obtained in practice and the control cannot be perfect in an actual experiment, incidental causes will somehow disturb the states. So, slight errors always accompany any demonstration or verification of a law which, therefore, must be conceived as true only ideally. No doubt is cast on its truth; the approximation of the experimental result to the theoretical proves, in fact, the truth of the law. All this is quite understandable. But Planck stretches this consideration too far and applies it to the case of inaccuracy which is treated by Heisenberg's principle. He confuses an inaccuracy which is due to incidental causes, (and which never disproves but proves, in fact, accuracy in theory), with an inaccuracy which does disprove accuracy in theory, having arisen from the nature of objects themselves, (*viz.* the small praticles being smaller than the wave length of light). Predictability, he adds, is never practically possible. This we admit. But Heisenberg's principle denies even the theoretical accuracy of prediction So the previous consideration cannot apply to this case and the allowance for a slight discrepancy cannot be made on the ground of "unavoidable experimental error". For the experimental error is here really unavoidable while that in ordinary measurements is avoidable in theory at least. The uncertainty is here in theory or in Planck's world-image itself; so, strict causality is in danger.

The world-image which Planck has in his mind is Schroedinger's wave picture. These waves somehow represent an electron and also a cluster of electrons. But, as he himself admits, these are far removed from the sense world; so, much inaccuracy and confusion arise when we transfer an actual problem to the world of waves, and, solving it, transfer it again to the sense-world. He says that the inaccuracy in prediction is due to the vagueness in the translation of symbols, not in the law itself. But this is a dodge. It only shifts the old problem to another sphere. For now we would ask—what is the use of such a wave picture which has the only function of saving causality in theory? The waves, we know, have no medium and they can represent sensibly either one electron or a large number of electrons in a cluster.[7] For they can represent two electrons only in six dimensional space, three in nine dimensional, and so on. So it is no matter of great consequence whether these waves, mere abstractions, obey a causal law or not.

Planck himslf must have felt this. The physicist's world-picture, according to his own criterion, should not be far removed from the actual world. He wrote, "The chief quality to be looked for in the physicist's world-picture must be the closest possible accord between the real world and the world of sensory experience. What is taken in through the senses is the first material that the physicist has to work upon".[8] The wave-picture has no accord with the actual world and so it cannot serve as a physicist's world-image. The wave-picture that saves causality does so at an enormously high price and Planck suspects it.[9] His attempt to save causality by taking recourse to a world-image is brave and he has opposed successfully the extreme positivists who insist on exact experimental demonstration of the causal law (which is impracticable) in order to believe in it. But Planck, in order to defend causality against the attacks of those positivists and idealists who have Heisenberg's principle as their chief weapon, has to strain his old argument to a breaking point and distort his world image so much that it ceases to be an image In this case, indeterminacy is shown to be not in practice only but in theory itself, that is, the world-image, which is a theoretical construction, is itself tainted with indeterminacy and so, Planck's argument loses all force Planck, feeling it, gives an alternative defence which requires his changing of the author of a prediction instead of the object; instead of an ideal world-image we have now to assume an ideal intellect.[10] We need not enter into this second theory, but we can note how Planck felt the inadequacy of the first while passing from one to the other. He writes,

> We were enabled to carry through the determinist view of the universe only by substituting the physical world-image for the immediate world of the senses Now the world-image is due to our imagination and is of a provisional and changeable character; it is an emergency concept, hardly worthy of a fundamental physical notion, and the question arises whether it might be possible to endow concept of causality with a more deep and direct significance by making it independent of the introduction of the artificial human product. [11]

If Planck cannot speak for the reality of the world-image as formed by wave-mechanics, he cannot prove the reality of the strict causal law. And his position would not be materially different from that of the logical positivists who admit the reality of observables (or verifiables) only, and who recognise entities and concepts of physics as aids to ordering of these observables, having no permanent reality, being but the work of imagination. For instance, Philip Frank writes, "Theoretical science is not research but a sort of remodeling of nature, it is the work of imagination."[12]

Philip Frank himself attempts, like Planck, in a way, to explain indeterminacy found in natural processes in terms of an indeterminacy involved in transferring symbols from the wave picture of the world to the actual world and vice versa Probability of an electron's behaviour, he says, can be predicted from its initial state. For these probabilities wave mechanics sets up strict causal laws. Now the indeterminacy (or the statistical element) arises only in translating certain symbols, *viz*, the squares of the absolute values of wave functions, to these are assigned "not individual experiences, but numbers which are obtained by averaging from a large number of individual experiences".[13] So the correspondence between experiences and symbols is not detailed but broad, and this appears as indeterminacy in the predictions. But this is no new thing (continues Philip Frank). Assignment of symbols to experiences always contains, a statistical element, *i.e.* a collective element for even when we observe single things, we take a mean value, our point-experiences are never recorded.[14]

Now, here we note the same confusion as we found in Planck's argument. When we measure a quantity we cannot but take a large number of observations and then take the mean value as the most correct one, for in this case the causes which prevent us from measuring accurately is supposed to be *in us* in so far as we cannot control the experiment and ward off accidental causes to influence our measurements and in so far as our sense-organs do not work with absolute accuracy in observations In this case, therefore, we are justified in setting up a world-image where exact magnitudes exist, and our mean values are regarded as approximating the exact values increasingly as we increase the number of measurements taken of the same thing. (By increasing the number of measurements the incidental disturbing factors are exhausted out). But with Heisenberg's principle came the notion of an indeterminacy that is objective, and in case of a single electron we can never go beyond a certain limit of accuracy (or rise above a certain limit of indeterminacy). Of course, in processes where large numbers of electrons are involved the inaccuracy *is negligible*, but that is *not* the point here. In the face of Heisenberg's principle, therefore, we cannot set up a world-image or a symbolical world where exact magnitudes may well exist and say that the inaccuracy is only in the correspondence between the symbols and our experiences. We should rather, *in this case, give up the symbols than save indeterminacy.*

Friend and Fiebleman also, like Planck, confuse an inaccuracy that is due to incidental causes with that which is found to be inherent in nature. So after arguing for causal laws as ideal, logical and non-temporal,[15] (quite correctly)from the consideration that no measurement can be exact in principle they conclude that quantum mechanics has not brought any change in the causal laws thus viewed. They argue that causal laws never really demanded absolute experimental verification because of the obvious and unavoidable errors in an experiment (which cannot be perfectly controlled); the statistical laws of new quantum mechanics only make this approximate exhibition of laws of nature more apparent. But the authors do not see the great change in the philosophical outlook on the matter brought by the new quantum-mechanical statistical laws. Classical statistical laws assumed strict causal laws to be working in nature and only for practical convenience used statistics, while modern statistical laws of new quantum physics claim that they are the only possible laws; the strict causal laws are a myth and only applicable in case of bodies of average size in which case the number of particles involved is large, and so, the probability is a practical certainty. So that the statistical laws are fundamental and the causal ones are only limiting cases of the former. That is the consequence of Heisenberg's principle. The epistemological status of new-quantum mechanical statistical laws is different from that of the statistical laws of classical physics (including those of classical quantum mechanics). While the latter are regarded as approximate interim laws to be replaced in time by strict causal laws applying to the details of experience, the former are regarded as ultimate. For classical statistical physics assumed the theoretical possibility of tracing individual elementary processes (while recognising its practical difficulties) but new statistical physics denies even this theoretical possibility. So that the contention that the statistical laws of physics are but interim approximate laws pointing to some absolute and ideal causal laws is unfounded. The *form* of a statistical law (in new quantum mechanics) is causal, no doubt, being a unique relation between different states of a system. But the *content* of such a law must not be overlooked; the states inter-related are represented by probability functions, and these do not apply to individuals of the system. With respect to content, therefore, these statistical laws are non-causal.

So, from this study we find that the formulation of causality as a pure form or an ideal function (rigorously true in a so-called real world which exists independent of our observation) does not work in the face of Heisenberg's principle of Indeterminacy. Besides the dualistic implications of such a formulation and its Platonic flavour, its great drawback is that it does not serve the purpose for which it has been made, *viz.*, rescuing strict determinism from the attacks of the Indeterminists.

REFERENCES

[1] Planck. Philosophy of Physics. Allen and Unwin, 1936.
[2] Friend and Fiebleman, What Science really means. Allen and Unwin, 1937.
[3] See *op. cit.* pp.50-58.
[4] *Ibid*, p.50.
[5] *Ibid*, p.61.
[6] *Ibid*, p.62.
[7] See Einstein and Infeld: *Evolution of Physics*, 306, 1938.
[8] See Planck: *Where is Science Going?* 85, 1933.
[9] *Philosophy of Physics*, p.61.
[10] See *Ibid*, p. 59.
[11] *Ibid*, pp. 68-69.
[12] Frank, P., *Between Physics and Philosophy*, 23, 1941.
[13] *Ibid*, p.99
[14] *Ibid*, p.100.
[15] Friend and Fiebleman: *What Science really means*, 1937. 173-185,

---

THE LYSENKO CONTROVERSY

D. K. MUKHERJI
CALCUTTA

SINCE 1935, when Trofim Denisovich Lysenko, then working in the regional agricultural station at Odessa in the U.S.S.R., on vernalization and plant breeding, began to overthrow the classical genetics to establish his own views on heredity, a controversy started, which gradually accumulated support from various quarters during the last decade within and outside Russia, as to the validity of his views. In this article a brief account of Lysenkoism—or the views propounded by Lysenko as it is called,—will be given along with some recent reactions of some of the eminent biologists on that subject after the August (1948)-session of the All-Union Lenin Academy of Agricultural Sciences. It has been stated that the Soviet State had accepted Lysenkoism as the only form of genetical science to be taught in the Russian Universities and had banned the teaching of the classical genetics from the U.S.S.R., as a result of which two most well-known biologists—Sir Henry Dale (England) and Prof. Hermann Muller (U.S.A.)—resigned from the Academy of Sciences of the U.S.S.R.

Lysenko, born in a peasant family in 1898, took training in the Horticultural Institutes and later at the Plant Breeding Station at Kiev, after which he entered as a member of the staff into the Azerbaijan Research Station where he did extensive researches on the vegetative period in plants, that formed the basis of his theory on the "Phasic development of plant" which, though not without criticism, got wide appreciation throughout the world. Very briefly, the theory of phasic development deals with the concept of different stages to be passed by the plant to complete its life-cycle. One of these stages depends upon temperature and is called the 'thermo-phase' the other depends upon light and is commonly called the 'photo-phase', and according to Lysenko these different phases are irreversible and follow in regular sequence; but later on other workers (Gregory and Purvis) have shown evidences of reversibility of these phases. Lysenko's work on the pre-treatment of seeds with low temperature—called Yarovisation or Vernalization—led to a considerable economic gain for the Soviet Russia by the use of this technique in a farm scale which, it is stated, made possible the growing of the cereals in millions of hectares of hitherto uncropped area in the U.S.S.R., and this line of work attracted the attention of many botanists and agriculturists all over the world. In 1930, he was transferred to Odessa Experimental Station, where he continued his breeding experiments and clearly postulated his views on inheritance for the first time in 1935 with the collaboration of I. I. Present. The following are the main aspects of his views which were dealt with and developed by him during the subsequent years:

(1) Transgressive segregation for earliness or vigour is not possible, that is, under suitable environmental conditions the F_1 hybrid from a cross between

an early and a late parent or between a vigorous and a less vigorous parent will always be early and vigorous, and that F_2 progenies will be less adaptable to the environmental conditions than the F_1 hybrid, as the potential adaptabilities gathered in the F_1 hybrid from the two parents segregate in the F_2 generation; (2) By continuous selfing the adaptabilities decreases, hence crossing is necessary for 'rejuvenation'; even artificial pollination within the pure line gives an impetus for being more adaptable; (3) The ovum is capable of selecting pollen grains which will produce the best adapted offspring from among a mixture of pollen grains. This he termed the 'selective fertilization; (4) Characters which are best suited to the local environmental conditions become dominant, hence dominance, in its generally adopted sense, is meaningless according to Lysenko; (5) The 'pure line' concept of Johannsen *is out of date, as within a* pure line, there arise a number of physiological forms due to the minute changes in the environmental conditions, (6) Genes are non-existant particles created out of the imagination of the supporters of the chromosome-theory of heredity, which *is merely an unfounded* theory; (7) 'Mendelism' cannot be supported on various grounds of which the fact that Millardet (France) found instances of non-segregating F_2 progenies (termed 'Millardetism'), is a strong support; (8) Grafting leads *to a flow of a supposed 'hereditary substance' from* stock to scion and *vice versa*, and renders the grafted plant to behave as a true hybrid; and (9) It is possible to change the heredity of a plant by changing the nutrient conditions in which a particular strain of a plant normally lives, this forms the basic idea behind the 'Theory of Nutrition' of Lysenko.

Another influence which is readily perceptible throughout Lysenkoism, is that of Darwin's conception of Natural Selection. Darwin's idea of environmental effects on variations in plants has been taken up by Lysenko to form a theory of the creative role of natural selection apart from its eliminative role by which Nature discards all the living forms which are not suited to a particular environment. This point of view has further developed by G. I. Popov, E. N. Sinskaja and others. Lysenko, throughout his work, stressed the importance of the study of the inheritance of physiological characters of economic value, which got meagre attention of the geneticists, although Mather's poly-gene concept gave a push to this aspect of study of genetics. Another point to be noted is the notion of Lysenko about the application of Mathematics to Genetics. Genetics is a science of elastic hypothesis, the laws of which can be fitted to any data by arbitrarily decreasing or increasing the number of genes, and by explaining the results by means of an entirely different subject called Statistics; and such a method is opposed to any biological principle. This is the view held by the followers of Lysenko.

It is very difficult to judge how far Lysenko's arguments are justifiable, but before discussing the pros and cons something should be mentioned about the previous workers who initiated some of these lines of research which formed a part of the foundation of the whole structure of Lysenkoism.

Firstly, mention may be made of I. V. Michurin, the Russian horticulturist, whose 'Mentor' method of grafting which involved grafting on a F_1 hybrid, was novel in idea, and his distant hybridization technique was appreciated all over the world; even Vavilov, the famous Russian selectionist, praised his work, although the theoretical aspect was not accepted by most of them. Michurin's influence on Lysenko was very great, so much so that in his address in the Lenin Academy of Agricultural Science in August 1948, Lysenko remarked that there was a "complete triumph of the Michurin trend over Morgan–mendelism" in the U.S.S.R, and that "the teaching of Michurin has been added to the treasure–house of our (Russian) knowledge, and has become part of the gold fund of our science" Michurin was held in high esteem by the Soviet State for his researches which brought an improvement in the fruit trees, for which he later received the Order of the Red Banner and the Order of Lenin, the highest honours in the U S.S.R for a scientist.

Another person whose name should be mentioned in connection with the development of Lysenkoism is that of L.Burbank, an American plant breeder, who adopted to some extent both the theories of Darwin's 'natural selection' and Lamarck's 'use and disuse', and postulated the theory that environment may influence heredity *if only the force exerted by the environmental* change on the living cells is strong enough to shake the stability of the living material.

The number of Lysenko's supporters gradually swelled up as he was supposed to be backed by the Soviet State. The chief supporter and co-worker of Lysenko is I. I. Present, who had published a book on Plant Breeding and the Theory of Phasic Development in collaboration with Lysenko, and also a series of papers on Vernalization in the Russian journal *Jarovizacija*. B. Keller associated himself with the Michurin Institute, and later with the Lysenko school, and published a paper in 1944 on Lysenko's views on the modern genetics. Among other supporters of Lysenko the names of Cicin, Slykov, Ermakov Zarkevin, Perov, etc., may be mentioned.

Although Lysenko was being backed by the Soviet State and vigorous propaganda was being made by the Lysenko school against the classical genetics during the last decade, yet there are quite a good number of active supporters of the classical school in the U S.S.R. even now, whose contributions in the various fields of genetics have become world famous Dubinin's work on population genetics, Serebrovski's work on animal genetics, and Navashin's cyto-genetical work are really mounmental and invaluable jewels in the treasure house of genetics. Those who opposed Lysenko for his anti-Mendelian outlook include such eminent scientists as Delaunay, Karpechenko, Konstantinov, Kostoff, Lisicyn, Sapehin, etc., some of whom are still now opposing Lysenkoism at every step even under humiliating circumstances, as it is often remarked.

Mention may now be made of N. Vavilov, the famous Russian biologist, and the former Director of the Institute of Genetics of the Acadamy of Sciences in the U.S.S.R., who led several expeditions to the different parts of the world to collect plant materials, and postulated a theory on the centres of Origin of the Cultivated plants, and the Law of Homologous Variation, which form some of the most valuable additions to the science of genetics. Vavilov, for his valuable scientific contribution, was made a Fellow of the Royal Society (England), but he was replaced by Lysenko as the Director of the Institute of Genetics in 1940, shortly after which he (Vavilov) died, the cause of which is still debatable, as the Soviet Government declined to give an open reply to the numerous enquiries from other countries regarding the great scientist's death. Vavilov was a strong defender of Mendelism throughout his life and that was supposed to be the cause of his degradation from the post of the Director of the Institute of Genetics. Gates'[1] account of the life and work of Vavilov will be of interest to the readers

Now, something must be mentioned about the historical trend in the development of Lysenkoism, and social and philosophical development in the U.S.S.R., which are to a great extent, responsible for so wide a success of Lysenkoism within a relatively short time. The dialectical materialism—the official philosophy adopted by the Soviet Union, founded by Marx and Engels, and developed by Plehanov and Lenin, deals mainly with the idea that everything is in a state of flux, and that there are two opposite elements simultaneously acting on matter (as for example, at the same time new cells are forming, while others are dying in the living organisms), the result of which is the changes in matter. As soon as one of these stops its activity no change is possible in the matter, and in case of living organism the latter dies

The concept of dialectical materialism has been explained differently by different persons, and have been utilized by them to explain their own views in the light of the state accepted philosophy. Even the scientists are not free from such explanations, a few instances of which in the field of biology are mentioned below:

N. P. Krenke, explaining the growth of the plant in the light of the concept of dialectical materialism in his book "The theory of cyclic senescence and rejuvenation in plants and its practical application", referred to senescence and rejuvenation as two opposite forces whose activity is essential for the plant-growth. While Lysenko and Present, supporting their views, accuse Mendelism as anti-Darwinism and opposed to the idea of dialectical materialism, A. R. Zebrak, defending Mendelism, accuses the former biologists as interpreting theory of dialectical materialism in a distorted way in order to achieve their own objects. In explaining the Nutrient Theory, Lysenko states that the interaction between the environment and the plant, during which the plant assimilates nutrients suited to its self, is responsible for the creative development of the plant, which in its turn is continually changing. He also points out that no biological organism is static, but is in a state of continuous change, which he called the "biological dialectic".

By now, the main traits of Lysenkoism have been dealt with mainly with reference to the modern genetics. The address given by Lysenko at the August (1948) session of the All-Union Lenin Academy of Agricultural Sciences, held during 31st August to 7th July, 1948, and attended by about 700 delegates, will now be briefly discussed with the mention of the various views expressed by other biologists during the discussion which followed Lysenko's presidential address.

Lysenko, in his 19,000—word address, dealt at length with the necessity of the teaching of Michurin's principles in the Russian Universities and emphasized his allegations against the Mendel-Morgan school of genetics. Lysenko states that he selected the materialistic aspects of Darwinism, but the 'reactionary biologists' developed the Malthusian idea of struggle within species which is contrary to the materialistic idea on the living nature. He praised K. A. Timiryazev, V. O. Kovalevsky, I I. Mechnikov, and V. M. Schenov for their adopting the progressive ideas from Darwinism, and accused I. I Schmalhausen, B M. Zavadovsky, and P M. Zhukovsky of accepting the erroneous aspect of Darwinism which can be found in the teachings of Weismann, Mendel, and Morgan whom he called the "founders of the modern reactionary genetics". He then pointed out that Weismannism, also called Neo-Darwinism as a disguise, along with the Mendelism-Morganism, denies the existence of any effect of environment on heredity, although environment is an essentiality for the manifestation of the vital functions. Weismannism further separates germplasm from somatoplasm, the former being unchangeable and only grows and multiplies, but is never generated again. These views, according to Lysenko, are "in essence metaphysical and ideological", and are "utterly unscientific", without any relation to the practical aspect of life. He defended to some extent the Lamarckian school as that takes into account the environmental effects on heredity and stated clearly that the "Michurin trend cannot be called neo-Lamarckian or neo-Darwinian. It is creative Soviet Darwinism." Quoting from N. K. Koltzov's paper on "The structure of chromosomes and metabolism in them" and M. M. Zavadovsky's book —"Dynamics of development of organisms", Lysenko stated that both of them following Weismannism, gave erroneous interpretation of heredity. Mentioning the view of I. I. Schmalhausen, the so-called Darwinist, that hereditary variation does not depend upon the conditions of life, Lysenko accuses Polyakov, Ployansky, and Zavadovsky, the eminent Russian geneticists, of their acceptance of his (Schmalhausen's) book as a "masterpiece in the creative development of Darwinism Then he turned to Schmalhausen and accused him of quoting the foreign and home-grown representatives of Morgan s metaphysics in his book—Factors of Evolution without mentioning the names of Michurin or Timiryazev inspite of the fact that the latter had published a book on the same subject (Factors of Organic Evolution) Lysenko appreciated the state policy to give support to the Michurin s teachings and condemned Zebrak and Dubinin of producing literally nothing of practical value inspite of that the former was placed as the head of an institution dealing with the investigations into the polyploidy and the latter was engaged in work n population genetics of Fruit fly for a long time

---

[1] *Science and Culture*, *12*, 423; 1947.

Lysenko now turns round to explain the Michurinite views as also his own on heredity Heredity according to him is the property of a living body to require definite conditions for life and development and to respond in a definite way to various conditions He emphasized his earlier statement that it is possible after two or three generations to turn the spring into the winter cereals or *vice versa* by vernalization Pointing out the Mentor method of producing vegetative hybrids by Michurin Lysenko reiterated his condemnation of the chromosome theory of heredity and referred to the plastic nature of the vegetable organism obtained from a shaken state by grafting by bringing the external conditions to bear upon them at definite moments during their development and by cross breeding He defined heredity in another way thus — Heredity is the effect of the concentration of the action of external conditions assimilated by the organism *in* a series of preceding generations He referred to Michurin s principle for converting a hard Wheat (*Durum type* 28 chromosomes) into several varieties of soft Wheat (*Vulgare type* 42 chromosomes) by planting in autumn for two to four years in which case no transitional forms were obtained and re-emphasized the practical importance of such principles and their necessity in the improvement of agriculture and forestry He pointed out the personal interests taken by Lenin and Stalin on Michurin teachings and remarked that the Michurin principles are the scientific principles and that the future belongs to Michurin He alleged that P M Zhukovsky s statement on the matter of thesis for University degrees in genetics encouraged the teaching and development of Mendelism Morganism and the Chromosome theory of heredity

In the concluding remarks Lysenko demonstrated various vegetative hybrids between a Potato and Tomato in response to Zhukovsky s challenge and referred to several strains of Wheat (*Lutescens* 062 *Melanopus* 069) which were claimed to have been produced by the Soviet Morganists but he stressed that they are only selections from the local strains the method employed having absolutely no bearing on Mendelism Morganism Without denying the presence of chromosomes and the experimental facts relating to chromosomes and the action of substances such as X rays Colchicine, etc which produce mutations Lysenko reiterates his belief that artificially produced polyploids can be of no practical use in farming and that chromosome has nothing to do with heredity He states that to the Morganists the living Nature appears to be a medley of fortuitous isolated phenomena and here chance reigns supreme hence the Morganists take recourse to the theory of probability and explains genetics in statistical terms whereas the Michurinists follow Michurin s slogan — We must not wait for favours from nature our task is to wrest them from her which is an idea completely devoid of fortuities and that is why the Michurin principles alone can be termed the exact science among the other biological views Lastly Lysenko called upon all the agricultural workers to unite and work in close co operation in the Michurinite line to transform the living nature for the benefit of the Soviet people and paid his respects to Comrade Stalin the great friend and protagonist of Science

Having mentioned the main points from Lysenko s speech it is necessary to point out a few of the various views expressed by various Soviet biologists at the discussion which followed the presidential address in order to form an idea of the views of the opposition group of Lysenko inside the U S S R

Zebrak defending the chromosome theory of heredity dealt with the work on polyploidy which he and his colleagues were engaged upon and stated that the greater capacity of adaptation to life conditions of the environment is the consequence of a greater number of chromosomes In replying to the accusation made by Lysenko that his work on polyploidy has contributed absolutely nothing to the practical side of crop production Zebrak referred to several instances where polyploids had greater yield than the diploids He cited the example of a tri haploid Wheat hybrid of the *Triticum compactum* type which increased its grain yield from 250 to 1 500 grains per plant when grown for five generations the weight of 10 000 seeds of polyploid Buckwheat was 25 grams whereas that of diploid was 18 28 grams tetraploid Millet also had larger grains He admitted that in a farm scale the overall increase in yield was not noticeable in any of the above cases due to the greater percentage of sterile plants among them but he was hopeful that polyploids would be of use later on in a wide scale In proving the utility of the chromosome study Zebrak stated that the increase in fruitfulness is directly proportional to the re establishment of chromosome pairing and that only the kinds with a balanced number of chromosomes are normally productive and are of interest for further selection In the concluding remarks Zebrak mentioned of the dialectical materialism and Marx s aphorism as confirmed by the work on polyploidy and of Comrade Stalin s instructions that the task of Soviet scientists is not only to reach but to surpass the acheivements of science abroad

I M Polyakov called the anti Darwinists as metaphysicists and neo Darwinist or the Weismannist and to this category fall Morgan Simpson Grigge, Shall, Mayer, and others He emphasized the role of metabolism on heredity, and stated that hereditary variability produced by environmental factors was physiological by nature and was "indeterminate". Disagreeing with the Malthusian teaching, Polyakov stated that he was a supporter of the teaching of struggle for existence within the species" and in this respect disagreed with Lysenko He paid respects to Timiryazev and Michurin for their "most fruitful ideas" and pointed out that he was not working "on an abstract problem of formal genetics, but on the study of an important problem, set plainly by Michurin, of selective fertilisation ' Referring to Lysenko's accusation that he (Polyakov) considered Schmalhausen's book a "masterpiece in the creative development of Darwinism ' even though the book had no mention of Michurin or Timiryazev, Polyakov stated that based on highly important and interesting biological, embryological, and ecological material, Schmalhausen's book was no doubt a masterpiece, although he admitted that there were debatable matters and mistakes in it During his talk Polyakov was interrupted several times by Lysenko and Present who raised many closely as well distantly related questions

B M Zavadovsky, like Polyakov, stated that he was ' an ardent supporter of the Michurin trend in science," and for more than twenty years he was leading a fight against the formal genetics and was in agreement with Lysenko as to the significance of environmental conditions on forming the breed and the kind, but he regretted that owing to the disagreement with Lysenko on several other points, he had been included among the supporters of the formal genetics Zavadovsky, in discussing his points in disagreement with Lysenko, stated that apart from the two view points, *e g*, Michurin—trend and Weismannism or the formal genetics so often mentioned by Lysenko and his supporters, there should be recognized another viewpoint, namely, that propounded by Timiryazev, whose work had been read by a very few worshippers of Lysenko, although all of them were supposed to hold him in high esteem Turning to explain the relation of Timiryazev's school of thought to that of Michurin's and Mendelism, Zavadovsky alleged that Lysenko and his colleagues had carefully neglected that part of Timiryazev s statements which dealt with the significance of Mendelism Although Michurin ironically called the Mendelian laws as ' the laws of Peas", Zavadovsky stated that he did not deny the worth of the Mendelian laws Turning to defend Schmalhausen, one of the famous pupils of the great evolutionary—morphologist Sekertsov, Zavadovsky stated that he (Schmalhausen) was a brilliant scientist carrying on work on Soviet Darwinism, even if he was not above criticism as also others including Lysenko himself Vigorously attacking Lysenko for his suppressing attitude towards those who differed from his (Lysenko) views, Zavadovsky referred to the works on polyploidy by Sakharov, Navashin and Zebrak, and the production of different wheat and rye varieties by Tsitsin and Konstantinov which were occupying millions of hectares in the U S S R , and suggested that these works of great practical importance should be awarded places of merit in the Soviet Socialist Agriculture He pointed out that except for the creation of chimera in the wings of butterflies, the vegetative hybridization, as explained by the Michurin school could not offer concrete suggestions as to how to apply the method to the animal world Extensively quoting Engel, Zavadovsky stated that "Darwin refuted Malthusian theory of over population in human society because he proved the esistence of over population in the plant and animal worlds", and alleged that Lysenko entered "on a contradiction not only of Darwin, Timiryazev and Michurin, but of the bases of Marxism-Leninism" Next, he praised the practical utility served by Lysenko s theory of phasic development and his enthusiasm in drawing the attention of the Soviet public to the works of Michurin, but he accused Lysenko of being one sided in accepting Michurin's teaching, giving primary attention to the problem of vegetative reproduction and grafting and ignoring that side of teaching which dealt with the sexual hybridization, which side was being developed so enthusiastically by N V Tsitsin and by himself Zavadovsky revealed that inspite of his strong criticism of Malthusian ideas in several of his publications he has been placed in the rank of the Malthusiasts and the formal geneticists by Lysenko and his followers, only because of the fact that he boldly pointed out the mistakes that were being done by Lysenko in putting a check to many necessary and useful trends of biological works In conclusion, welcoming an open discussion on the various points of doubt, Zavadovsky declared that, being an ardent follower of Timiryazev, he believed that heredity of determined characteristics were possible in plant organisms, but was unlikely to occur in animal organism, although according to his own experiments on vertebrates, he formed the opinion that it might be "possible to achieve a directed alteration through the endocrine organs, through definite chemical agents, antigene hormones"

I I Schmalhausen, in opening his talk, denied that he was a geneticist, but stated that he was a "morphologist, embryologist, philo geneticist" and a devoted pupil of Severtsov Although he was perhaps the first in the Soviet Union to criticise Weismannism, De Fricza and formal genetics, he alleged that Lysenko and his followers called him "an idealist and a formal geneticist " In discussing the possibility of heredity of determined variability, he referred to the artificially produced mutations and stated that as in nature, these mutations are also mostly undetermined Schmalhausen emphasized that individual part changes were harmful and selectionists should always seek mutations involving complex changes, as was always the case with natural selections He refuted the accusations that evolution was following a declining graph and the formation of breeds was gradually dying out by quoting from his book "Factors of Evolution" that "he was the first of the Darwinists to note the quickening of the process of evolution, not its slowing down," and referring to the selection of Sugarbeets for sugar content, he stated that the selection did not begin from the "dawn of cultivation", but only since the end of the last century Explaining his not mentioning the name of Michurin in his book—"Factors of Evolution,"—he stated that the book in question was only a special monograph on his "Theory of Stabilised Selection," and he did not mention any work published before 1920, but he referred to his book "Problem of Darwinism", published almost at the same time, where he paid tributes "to the truely remarkable achievements of Michurin,' Lysenko, Tsitsin and other Soviet selectionists Referring to Present's accusation that he supported Weismann's theory of "amphimixes,' in which it was considered that crossing was the source of variability, Schmalhausen stated that he was misinterpreted and that he believed that the external factors were the sources of variability and that crossing was a means "which permitted a more rapid combination and synthesis of the manifestations of different mutations "

B A Roubin, dealing entirely with the biochemical aspects of the development of potato, supported Lysenko's theory of phasic development and his view that "the demands of the plant on the environment entirely depend on its previous evolutionary history, from the kind of environment in which the plant was formed," and Darwin's idea of rhythmical movements in plants as a hereditary characteristics, and the possibility of breaking this regularity by determined influences

Among others in the discussion, S I Alikhanyan insisted on the necessity of the existence of different trends of thought in the scientific world if true discoveries were to be made, I A Rapoport stated that the principle of natural selection was incompatible with Lamarckism, and that Lamarckism in the form in which it was rejected by Darwinism, was accepted by Lysenko, V S Nemchinov, the director of the Timiryazev Academy, boldly supported the chromosome theory of heredity, which according to him was "a part of the golden fund of science "

The Praesidium of the Academy of Sciences, at the meeting on the 26th August, 1948, adopted a resolution "to turn biological sciences into a powerful weapon for modifying living nature in the interest of building a communist society," and agreed that

(1) Acad L A Orbeli would be replaced by Acad A I Oparin as the Secretary of the biological sciences Section, (2) Acad I I Schmalhausen would be relieved of his post as the Director of the Institute of Evolutionary Morphology, (3) The Botanical Cytological Laboratory as also the Cytological Laboratory of Acad N P Dubinin would be closed down, (4) Acad T D Lysenko would be a member of the Bureau of the Biological Sciences Section, (5) The plan of biological researches for 1948-50 should be done with the elimination of the followers of the Mendelism Morganism-Weismannism, and directing all the research work on the line of Michurin's teachings and for the need of the country's economy.

It is now the time to refer to the recent statements of some of the eminent biologists outside the U S S R, in order to have an idea of their reactions to the recent overall in the Soviet Biology The resignations of Prof H Muller (U S A), once the senior geneticist at the Moscow Institute of Genetics, a Corresponding Member of the Academy of Sciences in the U.S.S.R since 1933 and a Nobel Laureate, and of Sir Henry Dale (U K), the former President of the Royal Society and a member of the Academy of Sciences since 1942, from the Academy of Sciences led to a tremendous upheaval in the scientific world outside the U S S R In his resignation letter Prof Muller referred to the recent removal of such great scientists as Orbeli, Schmalhausen, and others from their respective posts and stated that "these disgraceful actions show clearly that the leaders of your Academy are no longer conducting themselves as scientists, but are misusing their positions to destroy science for narrow political purposes " Referring to the recent horrible changes in the Soviet Biology, Sir Henry Dale stated that the Academy of Sciences in the U S S R was "responsible for such a terrible injury to the freedom and integrity of science " In reply to Prof Muller, the official Soviet News Agency stated that "Soviet scientists resolutely oppose attempts to apply biological laws, including conclusions of Michurinite biology to social life There can be no science divorced from politics," and in reply to Sir Henry Dale, the Moscow Radio announced that Sir Henry's letter was "harmful to science and democracy," which contained very little of scientific arguments, being influenced mostly by non scientific principles

On the 2nd December, 1948, the B B C had arranged radio talks on the recent Lysenko issue by four eminent biologists,—Dr S C Harland, Director of the Institute of Genetics, Lima, Peru, Dr C D Darlington, Director of the John Innes Horticultural Institute, England, Prof R A Fisher, Balfour Professor of Genetics, University of Cambridge, and Prof J B S Haldane, Professor of Biometry, University of London Dr Harland termed Lysenkoism as "a new form of pseudo science ' which got the "official blessing" from the rulers of Russia Dr Darlington, in a very ironical way, referred to the success of Lysenkoism in theory and practice as simply based on bluff, and adorned Lysenko with such epithets as "the Ukrainian peasant" and "charlatan ' Prof Fisher, not satisfied with calling Lysenko a "scientific crank" or a "wrong headed yokel," accused him of aspiring for power—"power for himself, power to threaten, power to torture, power to kill." Prof Haldane was however cautious in his talk, and stated that although he did not believe a good deal of Lysenko's claims, such as that any character could be transmitted by grafting and so on, he did not disbelieve all of them, on the other hand he thought it wise to withhold the judgement on Lysenkoism till the full context of the discussions was translated into English.

Dr O H Frankel, Chief Executive officer and Senior geneticist, New Zealand Wheat Research Institute, in his letter to the Editor of 'The Listner,' stated that Lysenko's views on grafting and X'ray and colchicine treatments were entirely wrong, and accused Prof. Haldane of confusing and misleading the public as he "speaks with one voice to the scientists, with another to the public," although he praised Prof. Haldane's "distinguished record as a geneticist."

Prof. Eric Ashby of the University of Manchester, referring to Prof. Haldane's statement that colchicine treatment of seedling was consistent with Lysenko's views, stated that Lysenko himself spoke against colchicine treatment of plants as "torturing application" involving "maiming of plants" in 1940 (*Biologia Razvitia Rasteni*, p 287.), In another article Prof. Ashby, very briefly reviewing Lysenko's presidential address, expressed his deep sympathy for the degradation of soviet genetics due to the Soviet policy of stopping all the classical genetical works of such eminent scientists as Dubinin, Zebrak, Schmalhausen, and others, who were held in high esteem by the scientific world.

Prof. Haldane, in reply to Dr. Frankel's allegations, stated that his comments on Lysenko's views on grafting could be supported by Daniel's works (*C. R. Ac. Sci.*, Paris, *192*, p. 904; *195* p. 924 etc) and on induced mutations by Gustaffsson's works (*Hereditas 33*, pp. 58-59). He emphasized Lysenko's views that changes in the metabolism could bring about heritable changes in the progeny, could be supported by Stone, Hass, Clark and Wyass's work (*Proc Nat. Ac. Sci., Wash. 34*, p 142) on Bacteria, Kaplan's work (*Science, 108*, p 48) on flies.

Sir Robert Robinson, in his presidential address at the meeting of the Royal Society on 30th November, 1948, referring to the soviet biological changes, stated that "the incident is evidently of political rather than of scientific importance."

Prof. C. H. Waddington, Professor of Animal Genetics in the University of Edinburgh, in his long article in *The New Statesman* and *Nation* declined to believe the allegation made by many persons that Vavilov died in a concentration camp in Russia, and stated that although there was certain doubt about his death, the Russians refer to these allegations as "malicious calumnies," and that he himself was aware of only one case of execution of a geneticist in Russia, and that was of Agol, and that too not because of his genetical views, but for his political outlook. Referring to Prof. Muller's accusation of the "authoritarian control of science by politicians" in Russia, Prof. Waddington pointed out that total separateness of science and politics would not be possible even in America, and in case of Russia it was inconceivable due to their having entirely different socio-political outlook. Turning to the causes of success of Lysenko in the U.S.S.R., Prof. Waddington stated that he (Lysenko) provided a short term policy for the improvement of Soviet agriculture at a time when Russia was in great need for such a policy for the improvement of her vast area. Referring to Mendelism as a "sound long-term plan," Prof. Waddington expressed his discontent at the Soviet policy to "put their whole shirt" on Lysenkoism after they had allowed Mendelism and Lysenkoism to flourish "side by side for a couple of decades."

The above statements show that while there is one school which does not regard Lysenko's views as scientific and worth paying attention to, there is another school also which stress the importance of investigating into some of Lysenko's claims, though not all. "Upto the present few attempts have been done to approach the Russian school of genetics impartially" —this was stated by Hudson and Richens in 1946, and that is, on the whole not untrue even today. The two schools of thoughts, quite independent of each other, have been developed by their followers to such an extent that most of the workers in the field of biological science are biased in one way or the other. Above all, the influence of political situation on the minds of the scientists cannot be denied, in many cases it may have crept in their minds quite unknowingly, and that led to the fanaticism of the new Soviet biologists against the "foreign science," and the "anti-Soviet hysteria" of the scientists of the western world.

Lysenko's success in Russia is mainly due to his wide popularity among the peasant class, who found in him the embodiment of knowledge of agricultural improvement—not in words but in practice; his methods of planting potatoes, sowing millions of hectares with vernalized wheat, and utilizing the hitherto uncropped areas, brought for him the laurels of fame. In the political circles he became famous for his strong anti-western views, and for the economic gain brought about by his methods being employed in general farm practice in the Soviet Russia at the time when she was in utter need of "doing something big for her vast area". None can disregard Lysenko's work on the phasic development of plants and on vernalization, nor the work of Michurin on distant hybridization but controversy arises when he speaks of heredity. His conception about classical genetics that it is 'metaphysical' and 'idealistic', is based on ideas of some decades ago which disregard the progress made in the science of genetics since the time of Mendel and Morgan, can never be supported by any student of biology. It is agreed that the improvement of crops and stocks through Mendelian laws is a slow process, but it is sound. There can be no doubt that environment exerts profound influence on the life of an individual, and that the "Nutrient theory" of Lysenko can be accepted to a great extent, but whether acquired characters can be inherited in part or full, remains a matter to be settled by further elaborate experimental evidences, and this is also the case with the 'graft hybrids,' as the available data in these respects are not sufficient to formulate a general theory in this respect. Against the accusation of Lysenko about Statistics playing a prominent part in Genetics, it may be stated that none can deny the importance of Statistics not only in genetical but in all biological experiments, although there has evolved quite recently a separate line of work in genetics called Mathematical Genetics which is rather Mathematics than Genetics. Lysenko's arguments about the study of inheritance of physiological characters is justifiable, and there is no doubt that very little attention has so far been paid to this aspect of study, although it should have occupied the foremost position in the study of genetical science both from the theoretical and practical points of view. Lysenko's disbelief in the chromosome theory of heredity is merely one more addition to his many fanatical views, and it is unnecessary to deal with this point.

After discussing very briefly, the validity of different aspects of Lysenkoism, a few words about the Soviet state policy in putting a stop to the classical genetical works should be mentioned. It is a matter of deep regret that in this age of democracy and especially in such a country like Soviet Russia which claims to run on socialistic principles, scientists like Schmalhausen, Dubinin, Orbeli, etc., who are held in high esteem by all in the scientific world, for their valuable contributions towards the advancement of biological science, are to be relieved of their posts simply because they have their independent views which may differ from that now accepted by the State. Such a planned interruption in the sphere of science by the authority is really deplorable and harmful for the progress of science and for the independent and free scientific thought of the people. Putting a complete check on the progress of other trends of thought is no solution for a controversy, but what is necessary is an open and frank discussion between the followers of the different schools of thought and admit the shortcomings of their respective schools in order to form an impartial and unbiased outlook on the biological science If classical genetics is to be extinguished from the Soviet Russia, she will suffer from a~~n~~ one-sided, secluded and isolated development of biological science, and the world will lose many sincere devotees of biological science; on the other hand, the biologists outside Russia should pay more attention to Lysenko's claims and should repeat his experiments as far as possible to investigate into the problems in an unbiased way and with an open mind in order to find out any interesting conclusions arising therefrom. To distinguish between the "foreign science" and the "Soviet science" is simply a fanatical idea, for, in the words of Mr Harrison Salisbury, "In the past neither art nor science has been a respector of national frontiers, science is for the world, and the world will find out the scientific truth."*

References

Ashy, Eric *The Listner*, p. 813, Nov. 25, 1948, *Nature, 162* 912, 1948.

B. B. C. broadcast from London on Dec. 26, 1948.

Darlington, C. D *Picture Post*, p. 227, Sept. 25, 1948

Daily Worker, p 3, Dec. 15, 1948.

Discovery p. 324. Nov. 1948.

Frankel, O. H. *The Listner*, p. 889, Dec. 9. 1948.

Gates, R. R, Science & Culture, *12*, 423, 1947.

Haldane, J. B. S. *The Listner*, p. 931, Dec. 16, 1948.

Harland, S. C., Darlington, C. D, Fisher, R A, and Haldane, J. B. S. *Manchester Gaurdian Weekly*, p 2, Dec. 2, 1948

Hudson, P. S. and Richens, R H The New Genetics in the Soviet Union. Imp Bur. Pl. Breed. Genet., Cambridge, 1946

Lysenko, T. D. Soviet Biology, Birch Books Ltd. London, 1948.

Muller, Hermann *Discovery*, p 326, Nov. 1948.

Pl. Breed. Abs. 18, No 2,000, 1948.

Robinson, Robert, *Nature, 162*, p. 882.

Salisbury, Harrison, *Amrita Bazar Patrika*, Calcutta, p. 4, March 31, 1949.

Soviet Biology From the discussion on the Lysenko-report —Translated for the Engels Society, Duplicated by Express Duplicating Service, London.

The New Statesman and *Nation*, p 477, Dec. 4, 1948.

Waddington, C. H. *The New Statesman* and *Nation*, p. 566, Dec. 25, 1948

Wolstencroft, S. H. *The New Statesman* and *Nation*, p 526, Dec. 11, 1948.

Whyte, R. O. Crop Production and Environment, Faber & Faber, London.

---

* The author expresses his thanks to Prof. J. C. Sen Gupta, Head of the department of Botany, Presidency College, Calcutta for having kindly revised the manuscript and for his valuable suggestions.

DEMOCRACY AND AUTOCRACY

Autocracy is a master pirate who accepts tribute quietly, while democracy is a gang of hundred or more pirates who take their toll without warning or without stint.

Democracy stands for equality, but, as Plato says, equality of unequals is inequality. Hence, democracy substitutes equality by 'equality of opportunity' and thus changes itself into timocracy, which may be viewed as a synthesis of democracy and aristocracy.

GREY MULLET FISHING IN BARODA STATE

T V R PILLAY *

GREY mullets form a group of important food fish, the fisheries of which are significant in two respects in the fish supplies of Baroda State Though the majority of the 9 species of mullets identified from the State waters are marine, most of them ascend estuaries and creeks, and are chiefly caught in these regions While fishing in the open sea is seasonal, operations in protected estuaries and creeks are carried on all through the year On the Okhamandal coast, where the rainfall is very scanty, sea fishing goes on during the monsoon period also In the rainy season, when fishing is at a standstill in most of the fishing centres in the sea, mullets from the inland waters form the mainstay of the local fish markets Mullets being tasty and without fine bones, are relished even in the general fishing season, and they thus help to maintain supplies of wholesome fish throughout the year

CLASSIFICATION OF FISHING METHODS

Fishing for this ubiquitous and agile group calls for an abundance of enthusiasm and alertness on the part of the fisherman Though much ingenuity has been expended on the devising of gear, the fishermen are not always successful and often derive consolation only by dubbing the fish "Harami Machi" (Rascal fish)! The diverse implements adopted for mullet fishing in India can generally be classified as follows —

(1) Fixed or stationary nets
(2) Seine nets
(3) Cast nets
(4) Pouch nets and traps

Such nets are operated in estuaries and backwaters in Malabar, S Canara, Coromandal Coast and Chilka Special methods are employed in the Bengal estuaries to capture *Mugil Corsula*, the habits of which differ considerably from those of others of the family Grey mullets occur in the catches of many marine gears, but specialized fishing for them appears to be confined mostly to Gujerat, S Canara and the Gulf of Mannar areas

In Baroda State, the three scattered maritime districts represent three distinct types of mullet fishing areas, and with due reference to local conditions, the fishing methods and gear also vary In Okhamandal (*vide map*), where mullets yield the most lucrative fishery, the fishing grounds are the foreshore shallows of the sea Kodinar abounds in extensive creeks, and mullets are caught there mainly from such waters, whereas in Navsari the estuarine regions of rivers Poorna and Ambica are the chief centres of this fishery Of the four types of implements employed for Mullet fishing in India, three are in use in the State territories, *viz*, (1) fixed or stationary nets, (2) cast nets and (3) traps The two kinds of fixed or stationary nets employed are gill nets and barrier nets The gill nets are more widely used, and they have been devised with a fair knowledge of the habits of the fish This hardy and sportive fish escape by jumping off nets, and so gilling has been recognized by fishermen on these parts as the safest way for their capture In barrier nets extra provision is made to bag those trying to leap across the net barrier Even in the cast nets which are provided with peripheral pockets to hold enclosed fishes, the catches generally consist of gilled individuals A detailed account of the different nets in use for mullet fishing and their *modus operandi* is attempted below —

I GILL NETS

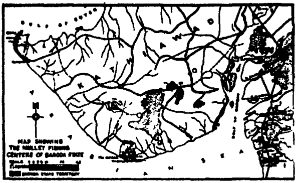
(1) '*Mangan Jal* On the Okhamandal coast where the most important mullet fishery is conducted in the sea, a large gill net is in use It is a single piece cotton net 800 to 900 ft long and 10 to 11 ft high, strung on a cotton head rope ½" thick, and a foot rope ¾" thick made of hemp To keep the net buoyed up when in operation, triangular cork blocks 1½" thick are tied to the head rope 10" apart In the middle portion every second or third float consists of double blocks of cork tied together This is to prevent the net from sagging low by its weight when in action Two to three feet of free rope is left at the ends to facilitate the working of the net Lead rollers about ½" thick strung at intervals of 8" keep the net upright and stretched during fishing The meshes are uniform and measure 1½" square

The fishing season for mullets on this coast extends from December to March with the peak period in February, and again from June to August During the latter season, when fishing in the sea is almost non existent in other centres, fishing is done here without much interruption because of the scanty rainfall and comparatively fair weather conditions The shoreward migration of "Mangan" (*Mugil cephalus*) in shoals appears to be determined by the winds, as the catches are satisfactory only when there is a good north east wind

The fishermen employed in this fishery are the Bhadelas of Beyt and Rupen, and the Karachi men who camp here during the season The Bhadelas is a small community of fishermen belonging to about 18 families confined to Okhamandal Each family owns a boat and a net Every season 6 to 8 boats arrive from Karachi These boats are dug out canoes 19'—20' long, 2½' broad and 2½' high The crew consists of 4 men. They build temporary huts and dis-

---

* Assistant Director of Fisheries, Okha, Baroda State.



tribute themselves along the coast, the main camps being at Port Okha, Aramda, Mojap, Rupen and Kuranga (*vide map*). The fishing grounds are the rocky shoals bordering the west coast of Okhamandal.

Each camp engages a couple of local 'Waghers' to reconnoitre a distance of about 10 miles and locate the presence of shoals in the locality. The shoals are seen as dark shadows moving through the water or recognized by their leapings from the water. With the shrewd powers of observation of the pirates they the 'Waghers' were once unequalled for this job, and their reports relied upon with advantage by the fishermen.

The boats drawn on the beach are generally kept ready laden with the net arranged breadthwise in folds in such a way as to make paying it out easy. When a shoal of fish approaches, the boat is launched with a crew of three; one man rowing the boat and each of the other two in charge of one side of the folded heap of net. As the fish draw near, the boat moves from the shore, leaving the free end of the net with a fisherman remaining on the beach. When the fish approach within range of the net the boat is rapidly rowed forming an arc with the beach as the cord (Fig.1). In the meantime, the two men in charge of the net pay it out, which now forms an arc-shaped wall enclosing the shoal. In their efforts to escape, the fish rush towards the wall and get themselves gilled in the meshes. To frighten them, the fishermen row about in the enclosed area and splash or beat the water with poles. The net is then hauled up quickly and carefully, so as to prevent any of the gilled fish from escaping In spite of all the skill and quickness of the fishermen, a good many of the fish leap over the net and find their way out. The catches per successful haul range from 300 to 1500 mangans of 10"-15" size. They are packed in crushed ice and transported to Okha Port by bullock carts. About 20 percent of the catches are sold in the local market or supplied to the calling steamers, and the rest exported to Bombay by rail.

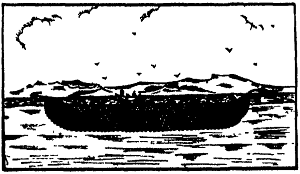


Fig. 1. Fishing for Mullets with 'Mangan Jal' Diagrammatic.

(2) *'Khandari Jal'*: This is a smaller gill net operated in the shallow creeks of Kodinar. On the east and west of the fishery port of Velan are large inland creeks affording good mullet fishing throughout the year. But the activity is naturally more brisk during the rainy season, because of the scarcity of other types of fish in the market.

The 'Jal' consists of a single piece wall of cotton netting 75 to 80ft. long and about 4½ ft. high strung on a ½" thick cotton head rope and a thinner foot rope of the same material. It is bound up by means of thin circular pieces of light wood or pith about 2" in diameter and ½" in thickness, tied to the head rope half a foot apart. During day time at high tide, the net is set in the form of a wall across the mouth of the creek from a tender canoe. The number of fishermen (Kharvas or Kolis) engaged in working a Khandari Jal is two or sometimes three. Generally one of them is a boy who takes his initial lessons in fishing in these creeks before venturing into the open sea. After paying out the net the tender canoe is rowed about in front of the net, and one of the fishermen beats the side of the boat with a wooden stick, so as to drive the mullets towards it. The frightened fish rush or leap against the net and get gilled therein. A good many find themselves landed inside the canoe in their frantic efforts to escape. The catches mainly consist of ***Mugil troschelii***, ***M. oligolepis***, ***M. waigiensis*** and ***M. seheli*** ranging from 4"-8" in size They are sold in the local market at eight to ten annas per kacha seer (½ Bengali seer) during the off season and at cheaper rates during the other parts of the year.

II. BARRIER NET

"Veri Jal" is a barrier net adapted for fishing in the shallow estuarine regions of Poorna and Ambica, Navsari and Billimora being the main centres of its operation. The size of the net varies with the width of the estuary or backwater where it is used. Hornell (1930) has described the net and the method of fishing as follows.

> "The barrier net (Veri) is a form of gill net stretched across a river from bank to bank and supported on vertical poles driven into the river bed. The net and its supports are in two sections, an upstream line of poles supporting a vertical curtain of net, and a second row, a few feet down stream longer than those in the first row. To the upper ends of these the head rope of a second curtain of net is tied, the foot rope being

secured at a lower level to the upper ends of the first line of poles. This upper net in consequence forms a sloping curtain sagging in the middle, at a higher level than the head rope of the vertical net

This net is worked during the latter part of the ebb, when the surface of the tidal stream has fallen to a level with or below the head rope of the vertical lower curtain As soon as this happens, some of the men 8 to 12 in number form in a line across the river at a considerable distance upstream often three to four furlongs away Each comes provided with a net of the cast net type but larger and somewhat more complex in the arrangement of the strings which induce the formation of the peripheral pocket These nets are laced together into a continuous line a stout head rope running along the whole line to which are tied long lengths of dry jowri stalks to act as floats The end of this head rope is carried ashore at each extremity of the line and half the number of men tail on to it on each bank slowly hauling it down stream towards the staked barrier This operation takes a considerable time to complete, well over an hour In this way the fishes are driven towards the barrier where they are either gilled in the vertical net, or caught in the pockets of the driving nets, or, in the case of grey mullets, stranded on the sloping net upon which they fall when they attempt as is their habit to leap over any obstacle that bars their passage

'Veri' fishing is a spectacular affair, and often a whole village gathers round to witness it Besides all estuarine species of mullets, many small sized fishes inhabiting these waters are caught in this net The catches are sold in the local markets, or when in excess railed to neighbouring places

III CAST NET

While the 2 types of nets described above are restricted in their use to particular areas, the cast net 'Hath Jal' is universally used for the capture of mullets in estuaries, backwaters and shallow inshore areas of the sea There are two types of cast nets used in the State waters, one with radial strings and the other without it The size of net and its meshes, vary from place to place according to the nature of the water and depth and size of fish that can be had in the locality The stringed variety is similar to such nets used on the Madras coast and has 6 to 8 radial strings meeting at the top and attached to a thick central hauling cord During hauling these radial strings induce the formation of a circular deep pocket wherein the fish are caught

'Mang Jal' is a cast net without the usual radial strings The mesh of this net generally increases from ½" square at the apex of the cone to 1" square at its base The weighted periphery has attached to it, a large number of short cords which are tied at points approximately two and a half times its length Thus a deep peripheral pocket is formed for the net

To catch the wily mullet with cast nets is by no means an easy job The fisherman has often to spend considerable time, patrolling along beaches or backwater banks to detect shoals of mullets that could be netted In the Aramda creek (Okhamandal) during the months of January and February, it is an engaging sight to see grey mullets of medium size collecting together near the sand sluices at low tides An interesting feature is their habit of forming lines, one behind the other and then circling round in rings, and again breaking up and swimming in straight lines When such a convenient shoal is sighted the fisherman very cautiously approaches, and throws the net over it The net forms a cone over the enclosed area and the hauling cord attached to a central point at the apex is slowly drawn up The fish in the area is then gravitated into the peripheral pocket as the net is hauled up

The catches of cast nets consist mainly of 'Boi' (*Mugil troschelli*, *M waigiensis* *M borneensis*), 'Moondha' (*M speigleri*, *M kelartii*), young ones of 'Mangan' (*M cephalus*) and 'Pambida' (*M oligolepis*, *M jerdoni*)

TRAPS

Unlike in other centres in India, traps are not very popular among fishermen here for mullet fishing A single instance of such a contrivance in use was observed to be employed by the 'Kolis' of Velan in the narrow creeks of the locality At low tide, a low bund of mud reinforced with stone is thrown across the narrowing portion of a creek, leaving a gap of about 3 ft in the middle A rectangular bamboo 'patta', 3' × 2' is placed in this gap in a slanting position, the slant being towards the back Behind the bamboo patta is placed one or two bamboo baskets (Fig 2) These are usually covered over with gunny sacs The mud wall is hidden with marsh plants serving as a camouflage measure Water from the creek flows through the gap, and over the bamboo patta which acts as a sort of sieve Fish brought in with the water, are either led into the basket below or stranded over the the patta Young and immature individuals are usually thus trapped.

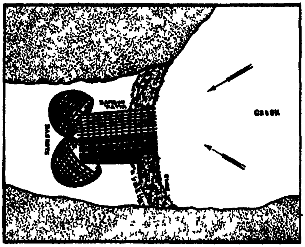


Fig. 2 A Mullet Trap (with the gunny cover removed)

Discussion

For lack of adequate data, it is not possible to assess with any amount of certainty the effect of the different fishing methods on the mullet stocks. The 'Mangan Jal' worked in the sea, does not appear to be in any way detrimental to the fishery. The large size of the mesh makes it possible for immature and undersized fish to escape. Moreover, as mentioned elsewhere, a good many adults also manage to escape by leaping over the net. Considering the poor catches brought in sometimes, the efficiency of this net is doubtful Kesteven (1942) describes a sort of 'Backing Net' used by Australian fishermen in conjunction with haul seines for mullet fishing. The fishes leaping over the seine, get automatically caught in this device Such an arrangement provided for the 'Mangan Jal' is bound to render it more efficient..

The position as regards estuaries and backwaters is rather different. Hornell as far back as 1930, observed signs of overfishing in these waters, especially with regard to mullets. A considerable proportion of the daily catches consists of young ones and the consumers naturally complain of its poor quality Hornell (1930) and Moses (1947) recommended the need for enforcing legislation to protect the estuarine fisheries by prescribing the minimum mesh limit. However, no action in this direction has been possible so far, due to the peculiar geographical position of the State territories Another means of checking such wholesale destruction of young ones is by penalizing the sale of immature mullets in the State markets. But any such restrictions can be enforced effectively only if the same policy is adopted in the adjoining areas of Bombay Province also.*†

References

Agricultural Marketing in India (1941)
"Preliminary Guide to Indian fish, fisheries and methods of fishing and curing". Marketing series No. 24

Hornell. J (1925) "The Fishing Methods of the Madras Presidency" Part I Madras Fisheries Bulletin XVIII.

————(1938): "The Fishing Methods of the Madras Presidency" Part II. Madras Fisheries Bulletin XXVII.

———— (1930) "Report on the Marine Fisheries of the Baroda State in 1930, with suggestions for their developments". Bulletin No. 30, Department of Commerce, Industries and Labour, Baroda State.

Kesteven, G. L. (1942) "Studies in the Biology of Australian Mullet. Account of the fishery and preliminary statement of the biology of *Mugil dobula* Günther".
Bulletin, Council of Scientific and Industrial Research, Australia No. 157.

Moses, S.T. (1947) "Baroda Fisheries" Bulletin No. XI, Department of Fisheries, Baroda State, Baroda.

Roxas, H. A. & Rasalan, S. B. (1936) "The Mullet Fishery of Nanjan, Mindoro". The *Philippine Journal of Science*, pp. 259-273.

Whitehouse. R. H. (1922) "The Grey Mullets of Tuticorin" Madras Fisheries Bulletin. Vol. XV. pp. 71-98.

---

*Since writing this article, Baroda State has been integrated with the Province of Bombay and effective legislation may now be possible.

†The author's grateful thanks are due to Dr T. J. Job, Chief Research Officer, Central Inland Fisheries Research Station, Calcutta, for his very useful suggestions and help, and Dr S. T. Moses, Director of Fisheries, Baroda, for the various facilities offered for making these studies

---

MAHARAJAPURAM SITARAM KRISHNAN

FIRST INDIAN DIRECTOR OF THE GEOLOGICAL SURVEY OF INDIA

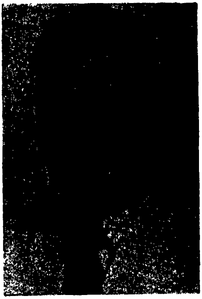
IT gives us great pleasure to record the news of the appointment of Dr M. S. Krishnan, M.A., Ph D , A.R.C.S., F.N.I., Director, India Bureau of Mines to act as the Director, Geological Survey of India, during the absence on leave of Dr W. D. West, C.I E , Sc.D., F.R.A.S.B., F.N.I.

Dr Krishnan is the first Indian to hold this important post as the head of the department which has nearly completed a century of useful existence. The Government of India have been very wise in selecting this distinguished Indian geologist of great calibre to guide the affairs of the Geological Survey at a time when the rapid industrialization of the country is being seriously pursued.

Although for the present he is to occupy the post as the head of the department only for a short period, we feel sure that his great drive and energy, his passion for hard work which spreads its influence around him, and his wide administrative experience would leave their impress on the future development of the Survey. He has in him the fitting combination of an active interest in the economic problems and a full appreciation of the necessity for less obviously useful studies in geology.

Born of a Brahmin family at Maharajapuram, Tanjore district, Madras Province, in 1898, Dr Krishnan has had a brilliant academic career. After taking his Honours degree in geology with distinction from the Presidency College, Madras, in 1919, he worked as demonstrator in the same college for two years with a break of about five months on an assignment as field geologist in the Central Province.

On the award of a scholarship in 1921, he entered the Imperial College of Science and Technology (Royal College of Science) London, receiving the A R C S and D I C in 1922 and 1923 respectively He was awarded the Ph D of the London University in the following year for his work, on a collection of rocks from Kathiawar carried out under the guidance of Prof W W Watts and Dr J W Evans He also received special training in mining geology during his stay at the Imperial College



Dr M. S Krishnan

Dr Krishnan joined the Geological Survey of India in 1924 as an Assistant Superintendent His field work was mainly in the Orissa States of Gangpur, Bamra Bonai Keonjhar, etc Later as the head of a party, he carried out numerous field investigations on mineral deposits, and initiated systematic geological mapping in several districts of the Madras Province

He acted as Lecturer in Geology in the Forest College, Dehra Dun, for three successive seasons from 1927 to 1929, and for two years (1933 to 1935) he was Professor of Geology, at the Presidency College, Calcutta During the latter period he was also in charge of the post of Curator (now designated Petrologist) in the Geological Survey and Museum

Dr Krishnan was Assistant Director of the Geological Survey from 1938 39 and a Superintending Geologist since 1945 Since 1940 he has had the responsibility of guiding the largest single field party and training several young geologists

He succeeded Dr Wadia a few months ago as the Director of the India Bureau of Mines at New Delhi, a new department created by the Government of India to look after the conservation and proper utilization of the mineral wealth of India

He spent a short period (1935 to 1936) in the U K, U S A and Canada on study leave acquiring knowledge of applied geophysics, and visiting important centres of mining and geological learning On his return in 1936, he was appointed a member of the Coal Mining Committee of the Government of India, the report of which contains a minute by Dr Krishnan and the late Mr H K Nag advocating nationalization of coal mines with the acquisition of royalty rights as a first step This was considered a revolutionary recommendation at the time, but has since found favour with the Indian Coalfields Committee of 1947 (*See* SCIENCE AND CULTURE, *12*, 511, 1947)

Dr Krishnan was a member of the Indian Science Delegation to the Royal Society Empire Scientific Conference held in England in 1946 In 1947 he was sent on special deputation to Europe and America to study the present methods of work in the investigation of rare and radioactive minerals and is now in charge of this unit organized by him in the light of his overseas experience He has been recently nominated *Chairman* of the Committee appointed by the Government of India to consider the problems in relation to the conservation of metallurgical coal and a *Member* of the Indian Delegation to the United Nations Scientific Conference on the Conservation and Utilization of Resources to be held at Lake Success in August 1949 (*See* p 30)

Dr Krishnan has made very valuable contributions to Indian geology More than fifty papers, chiefly dealing with mineralogy, petrology, mineral deposits and regional geology, have been published, including a *Memoir* on the geology of Gangpur State (1937)

As President of the Section of Geology of the Indian Science Congress from 1935 36 he made an important contribution on the classification of the Dharwarian of Chota Nagpur—their bearing on some problems of correlation and sedimentation at the Calcutta Session (1935)

Dr Krishnan has been very closely associated with the organization of the teaching of geology in several Indian Universities and is the author of a "Text book on the Geology of India and Burma" (1943, *now being reprinted*) and an Introduction to the Geology of India" (1944) He has also taken an active part in the promotion of scientific activities in the country Dr Krishnan was elected a *Fellow* of the National Institute of Sciences of India in 1935 *Editor of Transactions* of the Mining, Geological and Metallurgical Institute of India in 1949 and *President* of the Geological, Mining and Metallurgical Society of India for 1948-49 He is also a *Fellow* or a *Member* of the Indian Academy of Sciences, National Academy of Sciences of India, Indian Society of Soil Science, Indian Ceramic Society, Geological Society of London, American Institute of Mining and Metallurgical Engineers, Canadian Institute of Mining and Metallurgy, Society of Economic Geologists (U S A), and Mineralogical Societies of England, France, Switzerland, Germany and America.

For several years past, Dr Krishnan has been a member of the Council of the *Indian Science News Association*.

The Geological Survey, which is under rapid expansion, with its widening sphere of activities, will be greatly benefited by Dr Krishnan's remarkable capacity for organization. His friends and colleagues have gained much by his fund of knowledge and his firm grasp of field problems in geology. His sympathetic understanding has endeared him to his colleagues, and they will be glad to welcome him back in their midst, and wish him all success in the tasks that lie ahead.

Dr West who has been a popular and successful administrator, is proceeding on leave for a period of well-earned rest after three years of faithful service to the country as the Director, Geological Survey of India.

J.

Notes and News

IN MEMORIAM

Thomas Nelson Annandale

On the 10th April 1949, some past and present members of the Zoological Survey of India assembled at the Scottish Cemetery, Calcutta, to pay their respectful homage to the sad and loving memory of Dr Thomas Nelson Annandale, the founder-director of the Survey, who died on the 10th April 1924, twenty-five years ago. Wreaths were laid on the grave and those present stood in silence remembering his brilliant career in India, his erudite learning, his love for the staff and his manifold kindness and courtesies to many.

The Royal Asiatic Society of Bengal, with which Dr Annandale was closely associated as Anthropological *Secretary*, *Vice-President*, and as its *President* in 1923, perpetuates his memory by a triennial award of the *Annandale Memorial Medal* on a person for important contribution to Anthropology in Asia. The first award was made to Dr Fritz Sarasin in 1928 in honour to Dr Annandale's life work in physical anthropology. It is also in the programme of the Society "that the balance of income of the Annandale Memorial Fund be suitably invested until the accumulated amount is sufficient, after paying for the triennial award, to provide Rs. 250/- a year, to be utilized for a biennial Anthropological Lectureship."

Annandale was the last Superintendent of the Indian Museum and this office he held from 1907 to 1916. He succeeded Col. Alcock and relinquished the office on becoming the first Director of the Zoological Survey of India.

Lt. Col. R. B. Seymour Sewell, *Ci-devant* Director, Zoological Survey of India, wrote a review of Annandale's work in India which brings out very clearly how Annandale was far ahead of his times, for to him any taxonomic work involved correlation of the fauna with the climate, the geographical position and geological formation, the vegetation and the composition of the water of each district surveyed. He was of the opinion that "No one formula can express, much less explain, evolution." It was his intention to write a book on '*Evolution*' during leave which he intended to take when death snatched him away from us. His later writings show the magnitude of the loss suffered by the scientific world through his early death, for he had intended to incorporate the whole of his investigations and wide experience in his contemplated publication on '*Evolution*'.

TWENTY-FIFTH ANNIVERSARY OF CUSHMAN LABORATORY

The Silver Jubilee of the foundation of the Cushman Laboratory for Foraminiferal Research, Sharon, Mass., was celebrated on April 2, 1949, when congratulatory messages from micropaleontologists, oil geologists, general paleontologists, geologists and oceanographers from all parts of the world were presented to Dr Joseph A. Cushman, founder of the Laboratory, and who died soon after on April 16 last. (*See* SCIENCE AND CULTURE, June 1949, p. 519).

Since the Cushman Laboratory started functioning in 1923, a quarterly publication entitled "Contribution from the Cushman Laboratory for Foraminiferal Research" was inaugurated which has now completed 24 volumes. In addition the Laboratory published 24 special publications, which consist of longer papers, monographs and Cushman's book on the "Foraminifera, their Classification and Economic Use."

Prior to his founding the Laboratory, Dr Cushman had been a member of the staff of the U.S. Geological Survey for many years and also connected in various capacities with the Department of Geology at Harvard University.

Dr Cushman was a pioneer in demonstrating the usefulness of foraminifera in stratigraphy and oil geology. His conspicuous success in the economic use of foraminifera in the days when they were still regarded as long-ranging morphologically plastic organisms, gave the study and use of these protozoans an enormous impetus and yielded a financial return that later was used to build the Laboratory and to support his work in pure science Dr Cushman was the author and joint author of more than 520 papers and monographs His work has no parallel in the history of paleontology (*The Micropaleontologist*, p 3, April 1949)

NEW CARDIAC GLUCOSIDES

A very interesting cardiac tonic drug has been isolated from Jute seeds and studied in the Chemical Laboratory, Presidency College, Calcutta It is well known that jute leaves and seeds are used in our country as an *Ayurvedic* preparation in various ailments but no work was done regarding the chemical composition of their active principles The active principles were isolated in crystalline form from seeds of *Corchorus capsularis* by Prof N K Sen (*J Ind Chem Soc 7*, 83, 1930) and were found to contain several new glucosides of different melting points One of these, Corchorin having a melting point 174 175, was studied for its action on heart by Prof Sen and Dr N N Das (*J Ind Physio and Allied Sciences*, *2* No *1*, 1948) and found to contain an unsaturated lactone group It proved to be a useful cardiac stimulant drug

Professor Paul Karrer of the University of Zurich confirmed the above observation and indicated that Corchorin chemically belongs to digitalis group, a fact which corresponds to its pharmacological efficiency Recently the Pharmacology group of the Bristol Laboratories, Syracuse, New York, U S A studied the material sent to them and they fairly well collaborated the results presented by Sen and Das On further experimentation they found that 0 25 mg of Corchorin in saline i v produces a slight rise in blood pressure (15 mm) lasting for 4 min and increases in heart out put without changing heart rate Respiration was first greatly inhibited followed by an increased amplitude A 1 400,000 dilution produced a marked contraction of the intestinal gut of isolated guinea pig ileum, which is much greater than that produced by digitoxin in same dilution

Further work regarding the constitution of the new drug, Corchorin is now being studied in the Laboratories of Professors Paul Karrer at Zurich and N K Sen and N N Das at Calcutta

NEW ANTIOBIOTIC MAY OUTDO STREPTOMYCIN

Selman A Waksman, head of the department of microbiology at Rutgers University, New Brunswick, N J., and Herbert A Lechevalier, have announced in *Science* their discovery of an antibiotic which they call neomycin. Though animal tests are far from complete, evidence so far indicates that it may have a brilliant future in the treatment of tuberculosis

Dr Waksman discovered many anti tubercular antibiotics in a species of actinomycetic mold organism, but neomycin was the only one which met specifications ruling out toxicity, instability, and inability to overcome the acquired resistance of tubercle bacilli to streptomycin

When cultures containing neomycin were tested in animals infected with various resistant microbes other than tubercle bacilli, results were equally gratifying, because neomycin inhibited the growth of microbes which actually need streptomycin to grow

Neomycin has not yet been crystallized in pure form, so its chemical structure is as yet unknown All the work described was done with cultures that contain it Neomycin has so far proved superior to streptomycin in its power to inhibit tubercle bacilli in the test tube It is a basic compound, most active at an alkaline reaction, soluble in water and insoluble in organic solvents, and thermostable It is active against numerous Gram positive and Gram negative bacteria, but not against fungi Preliminary results point to its being distinctly different chemically from streptothricin and from streptomycin

CLINTON 59 OATS OUTYIELD ALL VARIETIES IN 1948 INDIANA TRIALS

Clinton 59 was Indiana's leading oat variety in 1948 tests conducted jointly by Purdue agronomists and county agents and farmers in 16 counties It averaged 67 bushels to the acre The regular Clinton variety was second yielding an average of 64 5 bushels

The performance of Clinton 59 in 10 counties, where it yielded an average of 73 bushels to the acre, was particularly satisfying to the growers The average test weight in these trials was 36 pounds to the bushel, compared with 35 5 pounds for Clinton and 37 pounds for the Benton variety (*Crops & Soils*, *1*, No 6, March, 1949, p 27)

THE RELATION OF ATMOSPHERE TO BIOLOGICAL EFFECTS OF X RAYS

Barbara Hayden and Lather Smith of the Department of Botany and Agronomy, State College of Washington, U S A have observed that barley seeds X rayed while in a vacuum consistently showed better germination and growth and a lower frequency of chromosomal aberrations than seeds X rayed in air In one test the seedling mutation rate from tests of plants grown from germinating seeds X rayed in a vacuum was 2 1 ± 0 32 per cent as compared with 3 4 ± 0.35 per cent for seeds X-rayed in air This difference was slightly more than three times the standard error Root-tip cells from seeds irradiated in air averaged 4 7 times as many chromatic bridges as root tip cells from seeds irradiated in a vacuum, (*Genetics*, *34*, p 26, 1949)

THE CYTOGENETICS OF SEX IN *HYPOMYCES SOLANI* F. CUCURBITAE

Hypomyces solani F curcurbitae is a heterothallic fungus comprising hermaphroditic, male, female and neuter strains. Such strains were crossed in different combinations and the resulting asci were examined cytologically. Asci developed after fertilization of a hermaphroditic thallus by a hermaphrodite show four pairs of chromosomes in the first meiotic division, one large, two medium, and one small. Asci of the crosses between male and hermaphrodite and between female and hermaphrodite show three bivalents and univalent. Asci of the cross between male and female have three pairs of chromosomes, one large, one medium, one small. From these investigations H. E. Hirsch of the Division of Pathology, University of California concluded that hermaphroditic races have a haploid chromosome number of 4, and when such a race mutates to male, it loses one of the medium sized chromosomes, if it mutates to female it loses the other. The reported production of hermaphrodites and neuters among the offspring of the cross male and female can then be assumed to be the result of occasional non disjunction of sex chromosomes. Cytological indications of non-disjunction were observed. Four homothallic strains of *H. solani* were all found to have a haploid chromosome number of 6. She also had suggested a hypothesis to account for the origin and homothallic character of such strains. (*Amer. Jour. Bot*, *36*, p. 113, 1949).

MULTI-PURPOSE LABORATORY IN THE HIMALAYAS

The proposal for setting up of a high altitude laboratory in the Himalayas was first mooted by the Government of India in 1947. The proposed Laboratory will have separate departments dealing with the study of snow, glaciers and their contribution to Indian rivers, astronomical and astrophysical observations, cosmic rays, biological and geological research, and research on the flora and fauna of the Himalayas.

An exploratory party, sent out last year to select a suitable location, recommended a spot near Kauripass, especially the 12,458 Ghorasan peak area which can be easily connected by a motor road with Toshimath, lower down on the route to the plains. A hydroelectric station and arrangements for water supply for the scientists colony can be established there without much difficulty.

A second exploratory party nominated by the Government of India this year are visiting some areas in the Sikkim Himalayas and the Middle Himalayas to gather more complete data before undertaking the project.

PLANT HUNTING IN INDO-BURMESE BORDER

Herbarium specimens of about 1,000 species have been collected on the Burma-India border during the past year by F. Kingdon Ward on an expedition initiated by the New York Botanical Garden. The purpose of the expedition, begun early in 1948, is to obtain plant material, especially ornamental species that will be suitable for culture in the U.S. To date, seeds of 260 plants have been received, none known to be cultivated in the U.S.A. The seeds have been distributed among the joint sponsors of the expedition —the New York Botanical Garden, the Huntington Botanical Garden of San Marind, California, Edward B. Stern of New Orleans, and Suydan Cutting of New York—and additional lots have been presented to growers in regions of the U.S. where they are expected to thrive. (*Science*, April 8, 1949, p. 370).

COAL FOUND IN GARO HILLS

A large deposits of very "high grade" coal have been discovered in Garo Hills in Assam. On sample analysis it has been found that, but for the sulphur content, the coal in these fields ranks among the best in India The Central Government will soon undertake a thorough prospecting of this area.

A thousand million tons of coal is likely to be available from a group of deposits in Garo Hills. Principal exposures of coal in this area are near Siju, Dapsi, Khosegari, and Dapsi Tholagiri It has been estimated that the deposits in Darangiri area would run to 76m tons. Except for sulphur, most of the coal was of very high quality, eminently suitable for such industries as cement, carbonization, and coal-tar distillation.

In a recent investigation in the Inorganic Chemistry Laboratory of the Calcutta University (See SCIENCE AND CULTURE, June 1949, p. 538), germanium has been found in the coal-ashes of Garo Hills in the order of about 0.1 per cent. Germanium is not only rare but very rare in the sense that it would be very troublesome to collect a few kilos of it in any part of the world. Since germanium metal has wide use in the field of electronics, this discovery of germanium in coal-ash is very significant. The analyst has claimed that the coal-ashes from Garo Hills is the best tapping sources for the extraction of germanium in India.

BERYLLIUM PLANT FOR ATOMIC USE

The U.S. Atomic Energy Commission has recently announced that the magnesium reduction plant at Luckey, Ohio, will be used for the production of beryllium metal and compounds for at least five years. During the war, the plant at Ohio was used to produce magnesium metal. Negotiations are in progress with the Brush Beryllium Company, Ohio, for the operation of the Luckey plant under contract to the Commission.

Beryllium can be used, like graphite or heavy water, as a moderator in an atomic reactor. Hitherto, the 13 known atomic piles in the United States, Canada, Great Britain and France, have used either heavy water or graphite as the control substance. The metal has not been purchased by the Commission since last August. Its previous uses in the atomic project were as a minor source of neutrons or in the manufacture of high temperature crucibles Outside the atomic field, beryllium is used in alloy manufacture and as coating in fluorescent lighting tubes

Because of the reported toxicity of beryllium special safeguards will be observed at Luckey plant Actual production operations are expected to begin in August (The *Chemical Age*, April 30, 1949)

A POSSIBLE METEORITE CRATER

It has been reported from the University of New Mexico that a possible meteorite crater has been discovered in north eastern New Mexico It is on a mesa 7,000 feet high, in an uninhabited area difficult of access The crater is nearly circular about 30 feet in diameter and three feet deep From its incomplete coverage by vegetation it is estimated to be less than 20 years old The crater may be associated with the meteorite fall of March 24, 1933, although it is much farther south and west than might be expected on the basis of authentic recoveries from that fall The crater was discovered during a search by members of the Civil Air Patrol for possible meteorites associated with a speectacular meteoric display on December 5, 1948 (*The Sky & Telescope*, May 1949)

VU EMULSION FOR ROCKET STUDIES

It is reported from the Kodak Research Laboratories that a new material, called a vacuum ultraviolet, or VU,—photographic emulsion, developed for identifying atoms or chemicals by analysis of their radiant energies, may be employed for study of the sun from rockets It may be used in the thin atmosphere 250 miles or more above the earth, or in near vaccum on the ground It is sensitive to light far into the ultraviolet The emulsion has extremely close-packed silver grains, with very little gelatin The gelatin of a normal photo emulsion absorbs ultraviolet light The new emulsion, with little gelatin, enables the ultraviolet light to be recorded

Ultraviolet rays of the sun are intense at high altitude, where the VU emulsion may be used While the sun's rays in this form cannot penetrate the atmospheres, study of them is important because they cause electrical disturbances in the upper air which affect weather and radio communications At high altitudes the atmosphere no longer filters out the ultraviolet solar radiations Hence the new emulsion was tested in a vacuum spectrometer where it was exposed to a high intensity spark rich in ultraviolet

URANIUM STRIKES

Two new potentially important finds of uranium have been made, in France and in Canada The French strike, according to Frederic Joliot-Curie, Director of the French Atomic Energy Commission will make France self sufficient in uranium France has had to depend on imports or very low grade domestic ores Its new find is a vein of pitchblende bearing 20 per cent uranium near St Sylvestre, a village in Central France

The Canadian discovery, on the Lake Superior shore 70 miles from Sault Ste Marie, was made late last fall, shortly before winter ended prospecting activities Samples of its pitchblende have assayed as high as 59 per cent uranium (*Scientific American*, April, 1949)

A NEW NEUTRON COUNTER

A small atom smashing device has been developed by the Westinghouse Electric Corporation to detect and count neutrons Neutrons defy all ordinary methods of detection and study since they carry no electrical charge and cannot be detected directly by electrical means The Westinghouse scientists took advantage of the atom splitting qualities of the neutron to devise a method for trapping them In the neutron counter, a small amount of uranium 235 is mixed with a special light-producing phosphor The mixture is coated on the surface of an electron—multiplier photo tube The whole device is contained within a metal cylinder which itself is lined with a 2" thick wall of paraffin to slow down fast moving neutrons When a neutron passes through the paraffin shield and strikes the uranium phosphor film on the tube, it splits the uranium atom or atoms In the tiny explosion which takes place, nuclear fragments are hurled off and strike the phosphors, producing light rays These light rays in turn produce electrons which then are multiplied a millionfold and collected at the end of the tube Thus neutrons recorded as flashing peaks of light on a fluorescent screen can be observed directly or the electrical impulses can be transmitted to electric circuits to give an accurate count of the atomic explosions taking place The new detector can count the particles cast off by the exploding atoms at the rate of 100,000 a second—fifty times faster than the standard Geiger counter (*Jour Frank Inst*, April 1949)

A NEW PLOUGH

A new plough has been designed in the Indian Agricultural Research Institute, New Delhi, in which the draught of two similar country ploughs coupled together in a certain way fell considerably short of that required for a single plough of the same design As a result of this factor it was decided to investigate the possibility of designing a double *desi* plough capable of operation by a single average pair of bullocks

The new plough as finally designed is simple in construction and consists of the bottoms only of standard *desi* ploughs, suitably coupled together by means of an angle iron frame work and pulled by a single central beam The ploughs are so spaced in relation to each other that identical furrows are cut and carry out in one operation similar work as would be performed in two operations by a single standard plough

This new plough is comparatively light, its weight being approximately 50 per cent heavier than a single plough, thus an average ploughman can easily lift and carry it as required for ordinary operational purposes The draft is, as already stated, tolerable, as instanced by trials in hand dry land, ploughing 4½" 5" deep, and using local Delhi plough bottoms the draft did not exceed 260 lbs The draft of a single similar plough under identical conditions was 155 lbs

The merits of the new plough are obvious Bullocks, in many instances and so far as ploughing is concerned are under loaded and there is considered little doubt that this new plough is capable of being operated by a single pair over considerable area in this country without undue extra effort and its daily output will be practically double Taking an extreme where due either to soil conditions or capacity of bullocks it is only possible to operate for 3 or 4 hours instead of 6 or 8 that is for only half of the usual daily working period the out-turn of work will be similar as for a full day and the cultivator given extra time for relaxation or alternative work In the case of a further extreme when soil conditions make the operation of the new plough impossible, this could be done as before with a single plough and subsequent second and third operations done in half the time with the new plough

Seasoned ploughmen who have used the new plough are enthusiastic about it and state that in operation it is easier and less tiresome to handle due to its 'stableness' when in work or simply—it works itself

When in production it is estimated that its cost will not exceed that of a single plough by more than 50 per cent Thus it will be cheap It is simple in construction and easily repaired or even constructed by the village blacksmith or carpenter and may well prove to be of great value in the effort being made today to increase food production and at the same time ease and improve the work of the Indian cultivator

INDIAN PHYTOPATHOLOGY

With modern methods of intensive cultivation of agricultural, forestry and horticultural crops, new and potent enemies of cultivated plants hitherto not so common, made frequent appearance and took their tolls of the fruits of the hard labour of the farmer Increasing attention was therefore beginning to be paid to the study of the nature of the damage, the extent of loss, the causes of such maladies and to devise measures to save the crops from such losses Through the laborious investigations of several generations of workers all the world over, the study of plant diseases and the methods of their control gradually developed into an exact science with its own methods and techniques with the turn of the present century

Spectacular has been the rise and development of plant pathology in North America, where agriculture is organized almost as an industry There plant pathology has, for the past several decades become separated from the customary department of botany, many of the leading colleges and universities in U S A and Canada have now separate department of plant pathology with adequate teaching staff and research facilities in different branches of plant pathology itself

It is a happy sign, particularly when India needs to save from depredations of moulds diseases and decay whatever crops she produces, that Indian workers are organizing themselves into a well knit body for the purpose of promotion of the science of plant pathology in India and actively contributing their share for the protection of agricultural wealth of the country by dissemination of exact knowledge on the subject and promotion of original research

Despite the specific meaning of the name of the journal, it publishes articles, besides those on plant pathology, on mycological and plant bacteriological topics as well The first issue of *Indian Phytopathology*, (published by the Indian Phytopathological Society, Pusa Buildings, New Delhi), just received contains a number of interesting articles being results of investigations by Indian workers on a few important problems in the country *viz*, late-blight of potato linseed rust, *Helminthosporium* disease of rice etc The present issue contains 96 pages and is nicely printed on art paper Editing has been well done though several typographical and a few other minor errors have occurred here and there Uniformity has however, not been observed in the style of abbreviating names of periodicals under References

The Indian Phytopathological Society, and especially its Secretary and Editor in Chief, Dr B B Mundkur deserve congratulations for the courage and labour undertaken to venture a new technical journal under present condition of scarcity of paper and high cost of printing The Journal will appear twice a year and the subscription is fixed at Rs 14 per annum

The Journal is highly commended to all agricultural institutions, places of advanced learning and reference libraries

LADY TATA MEMORIAL TRUST

The Trustees of the Lady Tata Memorial Trust announce the award of the following Scholarships and Grants for the year 1949-50

1 International Awards for research in diseases of the blood with special reference to Leucaemias

Dr M C Bessis, Paris, France, Grant of £250 for research expenses *Dr J Bichel, Aarhus* Denmark, Grant of £300 for research expenses *Dr Pierre Cazal, Montpellier*, France Grant of £130 for research expenses *Dr J Clemmesen, Copenhagen*, Denmark, Grant of £100 for research expenses; *Dr C. F. M. Plum, Copenhagen*, Denmark, Scholarship of £450; *Dr El. Kelemen, Szeged*, Hungary, Grant of £200 for research expenses; *Dr Edith Paterson, Manchester*, England, Grant of £250 for research expenses; *Prof.Edoardo Storti, Pavia*, Italy, Grant of £200 for research expenses; *Professor Charles Oberling, Paris*, France, Grant of £200 for research expenses; *Dr Jagdish Chandra Mehta, Agra*, India, Grant of £250 for research expenses; *Dr Pascou Atanasiu, Roumanian, working in Paris*, France, Scholarship of £400; *Dr. Gunther Schallock, Munster in the British Zone*, Germany, Grant of £270 for research expenses.

II. Indian Scholarships of Rs. 250/- per month each for one year from 1st July 1949 for scientific investigations having a bearing on the alleviation of human suffering from diseases.

Mr. Gangagobinda Bhattacharya, M.Sc., (Cal.), Research on Experimental Alloxan Diabetes, Presidency College, Calcutta; *Mr. Bimal Kumar Sur, M.Sc.*, (Nagpur), Further research on lucerne and search for other leafy vegetables of high supplementary value to poor South Indian diet, Central Food Technological Research Institute, Mysore; *Mr. K. Ramamurti, M.Sc.*, (Lucknow), Further research on rancidity in Indian Edible Oils with special reference to the deleterious effects of rancid dietary fat, Biochemical Laboratories, Indian Institute of Science, Bangalore, *Mr. Gauranga Roy, M.Sc.*, (Cal) Studies on the Mechanism of Blood Coagulation, University of Calcutta; *Mr D. V. Siva Sankar, B.Sc.*, To carry on research and work out a method for the estimation of Vaccinic Acid in Indian Oils and Fats and investigation of its growth-promoting action, Biochemical Laboratories, Madras; *Mr. P. R Srinivasan, M.Sc.*, (Banaras), Research on Protein Metabolism in relation to growth and age, Nutrition Research Laboratories, Coonoor.

ANNOUNCEMENTS

Trofim Lysenko has been given a First Stalin Prize (200,000 roubles), for 1948, for scientific research in the sphere of advanced Michurin Biological Sciences.

Dr S. D. Chatterjee of the Bose Research Institute, Calcutta, and Dr. D. Sharma of the Allahabad University have been awarded Post-doctorate Fellowships by the National Research Council of Canada for research in Physics in the Council's Laboratories at Ottawa. The Fellowships carry an annual stipend of $2,820 each.

Dr Harish Chandra, formerly of Allahabad University and now at the Institute of Advanced Study, Princeton, New Jersey, has been awarded Frank B. Jewett Fellowship by the American Telephone and Telegraph Co. The Fellowship carry an annual stipend of $3,000 to the recipient and $1,500 to the Institution at which he chooses to do his research.

Dr B. R. Seth of Hindu College, Delhi, will be serving as Visiting Professor of Applied Mathematics at Iowa State College during current year and will give courses in elasticity and hydrodynamics in the winter and spring quarters.

Dr D. Chatterjee until recently Botanist for India at Kew has been appointed Systematic Botanist at the Indian Agricultural Research Institute, New Delhi (See *Science and Culture, 11*, 134, 1945). During the three years of his service at the Kew Gardens he has published a number of research papers in this country and abroad. He has also regularly contributed to SCIENCE AND CULTURE.

During the summer of 1948 Dr Chatterjee represented India at the Utrecht Conference on Botanical Nomenclature and later toured several European countries, and worked in a number of well-known herbaria and has thus gained considerable experience in Herbarium organization.

Dr J. C. Saha has been appointed as Plant Pathologist to the Directorate of Plant Protection, Quarantine and Storage, Ministry of Agriculture, New Delhi. Formerly a Lecturer in Botany, Presidency College, Calcutta, Dr Saha was sent in 1946 by the Central Government for special training in Plant Quarantines in the United States, Canada and England.

The United Nations Scientific Conference on the Conservation and Utilization of Resources will open its three-week session at Lake Success, New York, on August 17th. This will be the United Nations' first step toward mobilizing science for the purpose of raising the Worlds' standard of living. The U.N.S.C.C.U.R. has asked 650 scientists to prepare papers on subjects ranging from projects for producing synthetic fuels to harnessing the wind for electric power. The conference will hold following sectional meetings: (*a*) Mineral Resources, (*b*) Fuels and Energy, (*c*) Water, (*d*) Forests, (*e*) Land Resources, and (*f*) Wildlife, Fish and Marine Resources.

Dr Frans Verdoorn, who has been Director of the Los Angeles State and County Arboretum at Arcadia near Pasadena, California, (See *Science and Culture 14*,380,1949, returned to his editorial, historical, and international relations work at Waltham, Massachusetts on April 15, 1949.

LETTERS TO THE EDITOR

[The Editors are not responsible for the views expressed in the letters.]

NOMENCLATURAL CHANGES OF SOME COMMON PLANTS OF THE *CUCURBITACEAE*

In pursuance of the international rules of nomenclature formulated by the International Botanical Congress in Vienna (1905), in Brussels (1910) and in Cambridge (1930) and subsequently adopted and revised by the Congress held in Amsterdam (1935), the specific names of many common horticultural and economic plants need revision. The sooner this revision is attempted, the better it will be for research workers the world over. The scientific names of at least the economic plants must be stabilized once for all. The matter demands immediate attention of the taxonomists. This revision will certainly be appreciated by all workers, particularly by those engaged in researches on economic plants.

While engaged on a taxonomic study of the Indian *Cucurbitaceae* the author endeavoured to arrive at the correct names of all the species occurring in the area surveyed. The names of the following common genera and species have been changed in the light of international rules.

Genus *Colocynthis* Ludwig. Up till now this genus is known as *Citrullus* after Forskal.[1] This name has been adopted by authors in different countries of the world, and the fact that Ludwig[2] had published the genus *Colocynthis* (= *Citrullus*) earlier in 1757 was overlooked. There are four species in this genus, all of which therefore need renaming. The correct names of these species with their more important synonyms are noted under:

1. **COLOCYNTHIS CITRULLUS** (Linn.) O. Kuntze, Rev. Gen. I (1891) 256; Thellung, Fl. Advent. Montpellier (1912) 493. (The Common Water Melon).

syn. *Cucurbita Citrullus* Linn Spec. Pl. ed 1 (1753) 1010, ed. 2 (1763) 1435.

Citrullus vulgaris Schrader in Eckl. et Zeyher, Enum. (1836) 279, in Linnaea XII (1838) 412.

2. **COLOCYNTHIS VULGARIS** Schrader Ind. Sem. Hort. Gotting. (1833) 2; O. Kuntze Rev. Gen I (1891) 256; Thellung, Fl. Advent. Montpellier (1912) 494. (The Colocynth).

syn. *Cucumis Colocynthis* Linn, Spec. Pl. ed. 1 (1753) 1011, ed. 2 (1763) 1435.

Citrullus olocynthis Schrader in Linnaea XII (1838) 414.

3. **COLOCYNTHIS NAUDINIANA** (Sond.) O. Kuntze Rev. Gen. I (1891) 256.

syn. *Cucumis Naudinianus* Sond. in Harv. et Sond. Fl. Capens. II (1862) 496.

Citrullus Naudinianus (Sond.) Hook. f. in Olive Fl. Trop. Afr. II (1871) 549; Cogn. in DC. Monog.Phan. III (1881) 511.

4. **COLOCYNTHIS ECIRRHOSUS** (Cogn) comb. nov.

syn. *Citrullus ecirrhosus* Cogn. in Verh. Bot. Ver. Prov. Brandenburg XXX (1888) 151, in Engler's Bot. Jahrb. X (1888) 270; Cogn. und Harms in Das Pflanzenr. IV 275. II (1924) 115

5. **LAGENARIA LEUCANTHA** (Duch.) Rusby, Mem. Torr. Bot. Club. VI. (1896) 43; Merr. Interpret. Herb. Amb. (1917) 493, Enum. Philipp. Fl. Pl. III (1923) 548, Trans. Amer. Phil. Soc. n. s. XXIV, 2 (1935) 380 (The Bottle Gourd).

syn. *Cucurbita lagenaria* Linn. Sp. Pl. ed. 1 (1753) 1010, ed. 2 (1763) 1434.

Cucurbita leucantha Duch. in Lam. Encycl. II (1786) 150.

Lagenaria vulgaris Seringe, Mem. Soc. Phys. Hist. Nat. Geneve III. 1 (1825) 25, t 2.

6. **LUFFA TUBEROSA** Roxb. Hort. Beng (1814) 104, Fl. Ind. (1832) 717.

Syn. *Momordica tuberosa* (Roxb.) Cogn. Monog. Phan. III (1881) 454; Cogn. und Harms in Das Pflanzenr. IV. 275. II (1924) 49.

Momordica Cymbalaria Fenzl in Kotschy, Iter Nubic. n. 149; Naud, in Ann. Sc. Nat. 4 Ser. XII (1859) 134; Clarke in Hook f. Fl Brit. Ind. II (1879) 618.

C. B. Clarke[3] transferred this species to *Momordica* after Fenzl (*l c.*) in Hooker's Flora of British India. This transference has been agreed upon by Cogniaux[4], and, accepting Roxburgh's[5] earlier publication, he made it a new combination *Momordica tuberosa* (Roxb.) Cogn. The fruit, however, of this species never agrees with those of *Momordica*. Roxburgh (*l.c.*) has very clearly elucidated this point. I have examined the specimens of this species very carefully, and I am unable to refute Roxburgh's observation. The fruit is never angular or ribbed in *Momordica*, whereas these are common features of *Luffa*. The absence of true cystolith in the lower epidermis of the leaf in *Luffa tuberosa*—a character common in *Momordica*—gives an additional support of its identity with *Luffa*.

The author acknowledges his thanks to Mr. H. K. Airy Shaw of the Herbarium of the Royal Botanic Gardens, Kew, for kindly helping him with references of *Colocynthis*.

H. L. CHAKRAVARTY

Botany School,
The University,
Cambridge, 10-3-1949.

---

[1] Forskal, P. Flora Aegyp. Arab, 167, 1775.
[2] Ludwig, C G Inst. reg. veg. ed. 2. 139, 1757.
[3] Clarke, C. B. in Hook. f. Fl. Brit. Ind. II, 618, 1879
[4] Cogniaux, A. in DC. Monog. Phan. III, 454, 1881.
[5] Roxburgh, W. Fl. Ind. 717, 1832.

THE DECOMPOSITION OF *KUROHI* ALKALOIDS

Basu and Mithal [1], [2] have shown that the process of assay of *Kurchi* alkaloids as recommended in the Indian Pharmaceutical List, 1946, is defective They suggested a method by which alkaloids can be extracted from the bark with least possible contact of strong alkali. The total alkaloids were estimated by following volumetric method of Lowdell[3] for assay of emetine.

It appears that *Kurchi* alkaloids are decomposed either by heat or due to long contact with alkali or due to both reasons.

We have done a series of experiments to ascertain the causes of decomposition of *Kurchi* alkaloids. In all the experiments one sample of *Kurchi* bark was used.

% total alkaloids as determined by I.P.L. method	% total alkaloids as determined by volumetric method Basu & Mithal	%alkaloidal residues as determined volumetrically	
		I.P.L. method (*a*)	Basu & Mithal's method
A	B	C	D
2.25	2.40	0.89	1.22
2.35	2 45	0.87	1.25
2.30	2.47	0.89	1 25

(*a*). The alkaloidal residue obtained after evaporating the solvent was dissolved in excess acid and titrated with standard alkali.

The values obtained both by gravimetric method of I.P.L. (Column A) and by volumetric method of Basu & Mithal (Column B) are almost the same and truly represent the total alkaloidal content in the bark.

It is also obvious that the *Kurchi* alkaloids are decomposed by heat (compare columns A and D.

The higher values of alkaloidal content in the residue obtained in Basu & Mithal's method (Column D) in comparison with I.P.L. method (Column C) indicates that longer contact with strong alkali further decomposes the alkaloid. Basu & Mithal's method of extraction avoids long contact with alkali.

The *Kurchi* alkaloids are decomposed by heat and strong alkali.

S. B. SEN GUPTA
A. B. DUTTA

Standard Pharmaceutical Works Ltd.
Calcutta, 29-3-1949.

---

[1] Basu N. K. and Mithal B. M. *Ind. Jour. Pharm.* 1947.
[2] Basu N. K. and Mithal B. M. *Ind. Jour· Pharm.* (July-Sept), 1947.
[3] Lowdell D P. *Pharm. Jour.* March, 1946.

NUTRITION OF THE YOUNG STAGES OF ESTUARINE FISHES OF MADRAS*

Along the coast line of the Madras Presidency, there are several estuaries, bays, lagoons, backwaters, marshes and mudflats, which afford facilities for fish farming Several species of the estuarine fishes are also suitable for acclimatization and culture in inland waters. These two aspects of fishery development cannot be successfully pursued without an intimate knowledge of the food and feeding habits of the fish concerned. Of the work so far done on the nutrition of the young stage of estuarine fishes, those of Job[1] Mookerjee, Ganguly and Sircar[2], and Setna and Kulkarn[3] are of special interest. In the present note the food of the fry of 14 species of estuarine fishes of Madras is given.

The food of 300 specimens of *Elops saurus*, Linn., examined by me consisted chiefly of small fishes like *Stolephorus* and *Gobius*, and crustacea like *Acetes*, young *Penaeus*, *Leucifer*, *Mysis* and *Rhopalophthalmus*. A similar diet is observed in the case of *Lates calcarifer* (Bloch) and *Lutjanus lineolatus* (Rupp.). But, in the case of the former the piscivorous tendency is more notable, and specimens of *Oryzias*, *Aplocheilus* and *Spratelloides* have been found in the stomach of over 75 individuals. *Diagramma crassispinum*, Rupp., feeds mainly on aquatic insects and their larvae, though packets of fish scales, polychaete worm (*Marphysa*) and filaments of *Oscillatoria* also occurred in some of the 60 stomachs examined. *Megalops cyprinoides* (Broussonet) and *Therapon jarbua* (Forskal) have a diet of smaller crustacea such as *Acetes*, *Caridina*, *Mysis*, *Cyclops Diaptomus Cypris Evadne*, *Daphnia*, *Nauplius* and *Megalopa larvae*, with diatoms and algal filaments as minor items. *Chanos chanos* (Forskal), *Ambassis commersonii*, Cuv. & Val., *Mugil dussumieri*, Cuv. & Val., and *M. oeur*, Forskal., are almost entirely plankton feeders. The planktonic organisms which usually enter their diet are *Hemidiscus Navicula Pleurosigma*, *Thalassiothrix*, *Coscinodiscus*, *Fragilaria*, *Nitzschia*, *Rhizosolenia*, *Planktionella*, *Cymbella*, *Gomphonema*, *Pinnularia*, *Biddulphia*, *Ceratium*, *Peridinium*, *Tintinnus*, larval bivalves, *Diaptomus*, *Acartia*, *Evadne*, *Acetes*, *Mysis*, *Leucifer*, *Nauplius* and *Megalopa* larvae Sand grains, mud and filamentous algae are however present in the stomach of the *Mugils* indicating occasional browsing habit Algal matter like *Oedogonium Cladophora*, *Spirogyra*, *Oscillatoria* and *Lyngbia* predominated the stomach contents of 120 and 300 *Scatophagus argus* (Bloch) and *Etroplus suratensis*, Bloch Diatoms and micro-crustacea were also met with in these species In 175 stomach of *Gerres filamentosus*, Cuv , fragments of gastropods and bivalve shells were found to be common along with worms (*Perinereis*, *Marphysa* and *Polydora*) and algae (*Ceramium* and *Polysiphonia*) *Sillago sihama* (Forskal) consumes chiefly polychaete worms, filamentous algae young prawns shrimps and amphipods

The food and feeding habit of the young ones of the above species thus show interesting variations As piscivorous tendency is found in *Elops saurus Lates calcarifer* and *Lutjanus lineolatus* their culture require special attention

P I CHACKO

Freshwater Biological Station
Kilpauk Madras
25 3 1949

Job T J *Rec Indian Mus* *42* 289 364 1940
[2] Mookerjee H K Ganguly D N and Sircar A *Proc* 33 *Indian Sci Cong* pt *3* 132 1946
[3] Setna S B and Kulkarni C V *Jour Bombay Nat Hist Soc* *41* 672 674 1940

*Communicated with the kind permission of the Director of Industries and Commerce Madras

---

PSYCHOLOGICAL TESTING OF A SECTION OF RAILWAY LABOURERS FOR THEIR PLACEMENTS

It is universally acknowledged that for our national well being the maximum production in all our industries is an absolute necessity It is also being increasingly accepted that for the maximum production all available manpower should be employed in such a way that every man is given the job to which he is best suited by his ability, training and temperament In this matter of putting the right man to the right job the science of psychology has rendered invaluable service in Europe and America, and it can do the same in this country

The main purpose of the present investigation was to find out how far psychological grading of the men as based upon the testing of ability and temperament would correlate with their present placements In other words, an enquiry was made to see whether the workers should be where they were, or whether they deserved promotion, demotion or removal to some other department to do different kinds of job

The tests administered were the following

A *Intelligence tests*

(*a*) Alexander Passalong test) Both are varieties
(*b*) Dearborn Form Board test) of Performance
) Test

(*c*) A short verbal intelligence test This test was a slight modification of the one which was used for testing a large number of lower subordinates during the last war by a number of the staff of the Psychology Department, Calcutta University

B *Mechanical Ability test* Stenquist Mechanical test

C *Temperament test* Neurotic questionnaire test of the Department of Psychology, C U

Every labourer tested was individually interviewed to ascertain home life, family condition, ambition in life, hobbies, feeling toward neighbours and supervising staff, etc

The records of merit rating, *i e* , estimation of the actual work of the labourers by their supervisors, were collected as far as possible,

The one hundred persons examined were composed of 30 semi skilled and 70 unskilled workers employed by the E I Ry at Chitpore and Barrackpore Railway yards The age range varied from 18 to 50 years The results of testing showed that most of the semi skilled ones were of good intelligence and possessed high mechanical ability Their placements left little to be desired *i e* they were fittingly placed by their employers A few cases of discrepancy which were noticeable amongst this class of persons could be attributed to their temperamental difficulties

With regard to the unskilled persons there was practically no correlation between their intelligence and special ability with their supervisors' estimate about them in many cases Some amongst them were found to possess better abilities but they were not exerting to the full measure in their work which was perhaps not interesting to them, and hence they had been left unnoticed They present cases of wastage of good material Some others are too low in intelligence and incapable of absorbing instruction and improving They should not be where they were

TABLES I AND II SHOW THE GRADING PERCENTAGE UNDER DIFFERENT NEEDS OF THE TWO GROUPS OF PERSONNEL, SEMI SKILLED AND UNSKILLED RESPECTIVELY

TABLE I

	Intelligence	Mechanical	Estimation	Ambition
A	13%	20%	20%	2 %
B	40%	37%	40%	40%
C	30%	30%	30%	24%
D	17%	13%	10%	13%
E	0	0	0	0

TABLE II

	Intelligence	Mechanical	Estimation	Ambition
A	3%	1%	5%	7%
B	14%	17%	13%	17%
C	46%	46%	45%	41%
D	27%	22%	23%	24%
E	10%	13%	14%	11%

TABLES III AND IV SHOW THE PERCENTAGE OF DISCREPANT AND NON DISCREPANT MEN OF THE GROUPS RESPECTIVELY

TABLE III

No discrepancy	Discrepancy		
	Temperament		Other reasons
73%	10%	27%	17%

TABLE IV

No discrepancy	Discrepancy		
	Temperament		Other reasons
49%	18%	51%	33%

Tables III and IV show the percentage of discrepant and non discrepant men of the groups respectively For skilled and semi skilled jobs the workers should have intelligence and mechanical ability along the average and they should be temperamentally balanced It has to be noted that the group of skilled or unskilled workers tested was a selected one The group of un skilled workers was fairly representative in character Amongst them 50 per cent of the men are not adjusted to their jobs

Thus the percentage of fit workers would have increased had the recruiting been based on suitable selection The desirability of introducing psychological tests for selection of personnel in order to mitigate wastage and bring about more harmonious adjustment of the worker to their jobs should receive the consideration of the railway authorities

Thanks are due to the railway authorities for the facilities given for testing a section of railway personnel and for the help received from the Department of Psychology, Calcutta University

(Miss) USHA BHATTACHARJI

Department of Psychology,
University College of Science and Technology,
Calcutta, 29 4-1949

ON CERTAIN UNSYMMETRICALLY SUBSTITUTED DIAMINO DIPHENYL SULPHONES

Since the observations of Buttle *et al*[1] and of Fourneau *et al*[2] on the activity of 4, 4—diamino diphenyal sulphone, numerous derivatives of this sulphone have been synthesized in an effort to reduce its toxicity for its application in the treatment of leprosy[3] and tuberculosis [4,5] Appropriate substitution of the amino groupings may not only diminish its toxicity but also help in enhancing its chemotherapeutic activity (*cf*, Mingoia and Berti,[6] Bauer,[7] and Calloman and Raiziss) [8] Accordingly, certain derivatives of 4, 4′—diamino diphenyl sulphone of the types (i) $\mathrm{RCONH\ C_6H_4\ SO_2\ C_6H_4\ NH\ \ CO\ R'}$ (ii) $\mathrm{R\ \ CH{=}N\ \ C_6H_4\ \ SO_2\ C_6H_4\ \ N{=}CH.R'}$ and (iii) R CO NH C H SO C H4 N=CH R′ are being prepared in the expectation that in the system they may undergo fission in a preferential way giving rise to a mono amino derivative so essential for the biological reaction [9,10]

4 Acetamino-4′ amino diphenyl sulphone prepared according to Raiziss *et al*,[11] treated with cinnamic, salicyl, p hydroxy benzaldehyde and anisaldehyde in alcoholic solution for about an hour when derivatives of type (iii) separated in deep yellow to orange crystals The 4 acetamino 4′ salicylidine amino diphenyl sulphono, for example, melted at 243 244°(Found N, 7 28 $C_{21}\,H_{18}\,O_4\,N_2\,S$ requires N, 7 1%) The corresponding symmetrical disalicylidine derivative of diamino diphenyl sulphone has been found by Calloman and Raiziss[8] to be superior to diasone (the diformaldehyde sulfoxylate derivative) in certain respects and the 4 amino-4 salicylidine amino diphenyl sulphone has been found to melt[12] at 222 223° (Found N, 7 47, $C_{19}\,H_{16}\,O_3\,N_2\,S$ requires N, 7 97%) The 4-acetamino 4 amino diphenyl sulphone again on refluxing with cinnamoyl chloride in alcoholic solution for an hour afforded the 4 acetamino-4 cinnamoyl amino diphenyl sulphone type (i) m p 234 235°, whereas the other type (ii) of the sulphone derivative is being prepared from 4 amino 4 arylidene amino diphenyl sulphone with appropriate aldehydes, thus 4 cinnamylidene amino 4 salicylidene amino diphenyl sulphone is being found to melt at 154-155° (decomp) The diacyl derivatives are not soluble in water whereas the other compound might be converted to water soluble derivative by reaction with sodium bi sulphite The characteristics of these compound are being described elsewhere

U P BASU
K R CHANDRAN

Bengal Immunity Research Institute,
Calcutta, 20 5 1949

[1] Buttle *et al*, Lancet, *232*, 1331, 1937
[2] Fourneau, *et al*, *Compt Rend*, *204* 1763, 1937
[3] Muir, *Trans Roy Soc Trop Med & Hyg*, *41*, (5), 575, 1948.
[4] Barry and McMalley, *Nature*, *156*, 48, 1945
[5] Brownlee, *Lancet*, ii 131, 1948
[6] Mingoia and Berti, *Chem Abs*, *39*, 2057, 1945
[7] Bauer *J Amer Chem Soc*, *70*, 2254, 1948
[8] Calloman and Raixiss, *Am Rev Tuberc*, *53*, 374, 1946.
[9] Smith *et al*, *Proc Soc Exptl Biol Med*, *64*, 261, 1947
[10] Klotz, J *Amer Chem Soc*, *66*, 459, 1944
[11] Raiziss *et al*, *J Amer Chem Soc.*, *61*, 2763, 1939.
[12] Jain *et al*, SCIENCE AND CULTURE, *11*, 567, 1946.

DIRECTIONAL OBSERVATIONS OF DISTANT ATMOSPHERICS DURING SUNRISE

A theory explaining the maxima in the number and strength of distant atmospherics about the time of ground sunrise and sunset was given by one of us[1] a few years ago A method[2] based on this theory has also been developed for locating distant thunderstorms by observing the time of occurrence of the atmospherics maxima, when the thunderstorms prevail over a period of time covering sunrise or sunset The object of the present communication is to present some typical directional observations of atmospherics about the sunrise time in the months of May and June of 1947 and to show that there is good agreement between the locations as computed from the directional observations of atmospherics and those obtained from the available meteorological data

According to the method already referred to, the location of a distant thunderstorm centre is obtained from the following equations

$$\Delta T = 4\phi \overset{\sim}{+} 2\,(\,_{s} - l_r) \qquad (1)$$

$$\cos\phi = \frac{R\cos\lambda_r + H_o/\cos\lambda_r}{R\cos\lambda_r + H_E/\cos\lambda_r} \qquad (2)$$

$$\tan\alpha = \frac{l_r \sim l_s}{\lambda_r \sim \lambda_s} \qquad (3)$$

where (180°$-\phi$) denotes the angle between the two tangents on either side of the ozonosphere from the point of reflexion in the ionosphere ΔT is the difference between the ground sunrise time and the time of occurrence of the atmospherics maximum, α the observed angle of arrival of the atmospherics, λ_s l_s & (λ_r l_r) represent the latitudes and longitudes of the source of the thunderstorm centre and the receiving point respectively, H_o and HE are the heights of the ozone layer and the E layer, and R the radius of the earth

The formula (1) prefers to a *single* reflexion at the ionosphere The lower (positive) sign of the formula is to be considered when ΔT exceeds 4ϕ minutes In this case the thunderstorm centre is to the *east* of the receiving point When ΔT is zero or less than 4ϕ minutes, the upper (negative) sign would be taken and it is to be inferred that the thunderstorm centre is to the *west* of the receiving point

If there are successive reflexions between the ground and the ionosphere there should be maxima one after another at regular intervals of time The difference between the ground sunrise time and the time of occurrence of each maximum and also the interval between the successive maxima for double reflexion, simultaneous single and double reflexions, triple reflexion etc can be easily worked out

The directional measurements were carried out at Dacca, East Pakistan on 1000 metres with a Cathode ray tube D/F equipment for 32 days in May and June 1947 Observations of the direction and magnitude of the linear response every 2 minutes on the oscillographic screen were made for about 45 minutes before and about 20 minutes after the ground sunrise The meteorological data regarding thunderstorms showed that thunderstorms occurred at one or more of the meteorological stations during the period of observations covering the sunrise time for twenty seven out of the thirty two days of observations. The directions of the meteorological centres which recorded local thunderstorms during the sunrise period were found with reference to Dacca (Lat 23° 7 N, Long 90° 4E), and for these specified directions, the number and total strength of the atmospherics in 2 minutes were plotted against time The maxima in the number and the maxima in the total strength of the atmospherics were found to appear at the same time Six typical sets of observations are illustrated in Fig 1

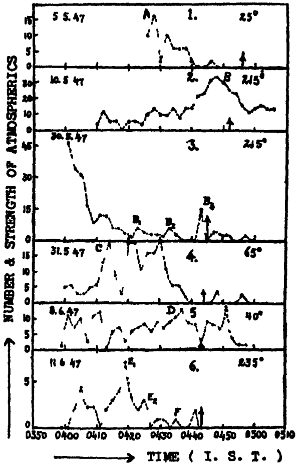


Fig 1

Directions measured in degrees with reference to North in the clock wise sense

A	Gauhati (Assam)
B	Nagarcoil (Madras Presidency)
C	Srimangal (Assam)
D	Ongole (Madras Presidency)
E	Alipore (West Bengal)
F	Sambalpur (Orissa)

The arrow indicates the time of ground sunrise

The location of thunderstorm centres computed from the time of occurrence of the atmospherics maxima are found to agree well with the thunderstorm data This is shown in Table I Computation is based on the value ϕ being 6°3 which is obtained from (2) by taking the ozone layer and the E layer heights to be 45 km, and 90 km respectively

It is to be noted that the observed atmospherics maxima indicated the occurrence of thunderstorms in all directions up to a range of about 2000 km The locations of thunderstorm centres at places other than the meteorological stations are however not given in the table The maxima marked A,B,C,D,E and F in fig 1 indicate thunderstorms which occurred at certain meteorological centres during the period of observations covering the sunrise time Only in four or five cases out of nearly forty the recorded thunderstorm did not cause the expected maximum This must be due to long distance or mildness of the thunderstorm discharge

TABLE 1

Date	Meteorological data regarding thunderstorm centres				Computed Location	Number of reflexion
	Time I S T	Place	Distance from Dacca	Location		
(1) 5 5 47	0000 0600	Gauhati (Assam)	300 Km	Lat 26°11 N Long 91°47 E	Lat. 26°10 N Long 91°48 E	Single
(2) 10 5 47	0310 0530	Nagarcoil (Madras Presidency)	2205 Km	Lat 8°11 N Long 77°29 E	Lat 8°36 N Long 79°48E	Single
(3) 30 5 47	0335 0740				Lat 7°30 N Long 76 48 E	Triple
(4) 31 5 47	0000 0600	Srimangal (Assam)	178 Km	Lat 24 22 N Long 91°18 E	Lat 24 48 N Long 92°18 E	Single
(5) 8 6 47	0315 0800	Ongole (Madras Presidency)	1409 Km	Lat 15 30 N Long 80°6 E	Lat 14 6 N Long 80 46 E	Single
(6) 11 6 47	0417 0507	Alipore (West Bengal)	22 Km	Lat 22°32 N Long 88 24 E	Lat 22°42 N Long 88°18 E	Doubl
	0430 0520	Sambalpur (Orissa)	706 Km	Lat 21°28 N Long 84°1 E	Lat 19°42 N Long 81 48 E	Single

There were evidences of multiple reflexion in the ionosphere One case of triple reflexion marked (B^1 B^2 B^3) in No 3 and one case of double reflexion marked (E^1 F^2) in No 6 are only shown in the diagram

Our thanks are due to the Director General of Observatories of the India Meteorological Department for kindly supplying us with the thunderstorm data

Banaras Hindu University, Banaras S R KHASTGIR

University College of Science &
Technology, Calcutta, R ROY
20 5 1949

---

[1] Khastgir SCIENCE & CULTURE, *11* 233, 1942
Khastgir and Innas Ali, *Ind Jour Phys 16*, Part IV 399, 1942

[2] Khastgir, Das Gupta & Ganguli, *Nature 159*, 573 1947
Khastgir Das Gupta & Ganguli, *Ind Jour Phys 21* Part IV 169, 1947

STUDIES IN THE CATALYTIC PRODUCTION OF BUTADIENE FROM ETHANOL, PART IV

In continuation of our previous work [1], [2], [3] on the catalytic production of butadiene from ethanol by the Lebedev process, a new catalyst has been developed which gives promising results The catalyst consists of the components magnesium oxide, silica, aluminium oxide in the proportions 52—13 7—3 5 respectively Studies have been undertaken at two different space velocities The results obtained are given in tables 1 and 2 (*See* p 37)

It will be observed from these tables that a higher space velocity is favourable to the production of butadiene, for this catalyst The faster rate of delivery does not seem to affect the alcohol split as can be seen in columns 2 and 3 in tables 1 and 2 This indicates that the catalyst is very active, the comparatively lower yield of butadiene in the first series of experiments being due to the decomposition of butadiene over the catalyst zone owing to greater contact time, and denotes that a space velocity higher than 1 538 may give a better yield of butadiene without impairing the alcohol conversion efficiency of the catalyst Experiments in this direction are being undertaken

To a solution of sodium silicate was added nitric acid and this was followed by the respective metallic nitrate solutions The metallic carbonates were precipitated over silica by the addition of a solution of potassium carbonate The precipitate was washed free of potassium nitrate and dried in an oven for 24 hours. It was powdered to 100 mesh and activated

TABLE 1

Data for catalyst IV 1st series of experiments	Temperature 375°C	 400°C	 425°C	 450°C	 475°C
1 Alcohol feed stock—absolute alcohol distilled over calcium	50 cc	50 cc	50 cc	50 cc	50 cc
2 Alcohol returned %	42 31	18 11	3 53	3 15	2 10
3 Alcohol converted % (by diffce)	57 69	81 80	93 47	96 85	97 9)
4 Rate of delivery of alcohol -c c /hr /g of the catalyst	0 769	0 769	0 769	0 769	0 76)
5 Gas collected on litres (at N T P)	6 30	12 33	18 05	19 13	20 51
6 Composition of the gas (by volume)					
Unsaturated hydrocarbons	57 03	59 28	54 23	52 97	46 92
Hydrogen	27 92	29 69	30 47	30 00	32 83
Carbon monoxide	1 56	1 55	2 91	2 70	2 82
Staturated hydrocarbons	3 39	2 84	3 44	5 41	6 07
Butadiene	24 11	23 15	19 39	19 91	15 69
7 Butadiene content of gas	0 581	0 558	0 468	0 480	0 80
8 Yield of products expressed as % by weight of absolute alcohol converted					
Hydrogen	0 70	1 04	1 32	1 37	1 61
Butadiene	16 19	21 78	22 52	24 36	65
9 Production of butadiene on the basis of the theoretical yield from ethyl alcohol	27 59	37 11	38 37	41 52	3) 18
10 Process yield of butadiene	9 34	17 83	21 71	23 60	20 21

TABLE 2

Data for catalyst IV 2nd series of experiments					
1 Alcohol feed stock absolute alcohol distilled over calcium	50cc	50cc	50cc	50cc	50cc
2 Alcohol returned %	55 75	15 57	15 57	5 9)	1 76
3 Alcohol converted % (by diffce)	44 25	63 10	84 43	94 04	98 24
4 Rate of delivery of alcohol—c c/hr g of the catalyst	1 538	1 538	1 538	1 538	1 538
5 Gas collected in litres(at N T P)	4 23	8 41	13 71	16 59	18 74
6 Composition of the gas (by volume)					
Unsaturated hydrocarbons	41 34	48 12	54 59	55 35	49 20
Hydrogen	42 31	33 16	26 83	29 79	30 68
Carbon monoxide	3 37	1 07	2 55	2 02	3 16
Saturated hydrocarbons	1 92	5 88	3 06	4 80	5 53
7 Butadiene content of gas g 1	0 497	0 517	0 599	0 584	0 536
8 Yield of products expressed as % by weight of absolute alcohol converted					
Hydrogen	0 93	1 02	1 00	1 21	1 3)
Butadiene	12 14	17 66	24 91	26 36	26 21
9 Production of butadiene on the basis of the theoretical yield from ethyl alcohol	20 66	30 10	42 44	44 91	44 66
10 Process yield of butadiene	5 37	11 14	21 03	24 78	25 74

for 24 hours at 375° 400°C Water was added to the powder thus obtained and the catalyst caked out on a Buchner, and dried When semi dry, pellets of the size 7 to an inch approximately were made and dried in an oven for 24 hours at 100°C 65 grams of the catalyst were taken for these studies

Our thanks are due to Prof B Sanjiva Rao for providing facilities for this work, and to Sir J C Ghosh for the keen interest evidenced in these studies

R SRINIVASAN
G D HAZRA
Pure and Applied Chemistry Department,
Indian Institute of Science,
Bangalore—3, 24 5 1949

---

[1] Srinivasan R and Hazra G D, SCIENCE AND CULTURE, *14* 436-37, 1949

[2] Srinivasan R and Hazra G D, SCIENCE AND CULTURE, *14* 480 481, 1949

Srinivasan R. and Hazra G D, SCIENCE AND CULTURE, *14* 532, 1949

Lebedev S V, Russian Patent no 24, 393, 1931, and British patent no 331, 482, 1930,

THE EFFECT OF NaOH AND UREA ON THE DIFFERENTIAL STAINING OF THE POLLEN GRAIN NUCLEI*

A technique which would rapidly and differentially stain the pollen grain nuceli, and would be, at the same time, universally applicable, is a great desideratum Aceto-carmine technique, usually so handy, frequently fails to yield the results desired Tiwary[1] effected an improvement by pre treating the pollen grains with NaOH before staining with aceto-carmine Later, he evolved a variation of the method which gives still better results This consists in treating the pollen grains in carmine powder *dissolved* in NaOH and gradually warmed to dryness On subsequently adding sufficient 45% acetic acid to neutralize the alkali, a high degree of differentiation is *automatically secured*

Now, it is well known that addition of substances apparently inert themselves to fixatives and other reagents, has, for unknown reasons, a profound influence[2]. For instance, the incorporation of urea in Bouin's fixative in the well known Allen s modification gives a superior fixation Kodani[3] also has used a mixture of NaOH and urea in the study of the *Drosophila* chromosomes We, accordingly, decided to try the effect of adding urea to NaOH For this purpose the mixture used by Kodani (equal quantities of saturated aqueous solution of urea and 1/N NaOH) was taken The results obtained have been satisfactory beyond our expectation

Fresh pollen was treated with the above mixture on a slide and *gently* warmed to dryness Sufficient aceto carmine in glycerine was, thereafter, added Immediately, both the vegetative and the generative nuclei stood out *brilliantly* stained The nuclei were not only more deeply stained than when the pre treatment was done with NaOH only, *but the vegetative nucleus was as brilliantly stained as the generative nucleus*, a result as unexpected as it was satisfactory, and which so far, has not been given by any other rapid technique However, it is necessary to mention that plasmolysis seems to ensue and affect the morphology of the nuclei adversely It is proposed to make critical comparative studies in this connection at a later stage But for our immediate purpose, *viz*, counting the number of nuclei this is immaterial, and the results are all that could be desired

To increase the contrast, the cytoplasm was stained with light green by a method of double-staining devised by us This will be reported in due course

The above technique has been tried on the pollen of *Solanum nigrum* We propose to use it on other pollens as well †

N K Tiwary
Shankerji Shrivastava

Botany Department,
Banaras Hindu University, Banaras
1 6 1949

---

*The first note of the series was published in *Science & Culture 13* No 9 p 390 1948

†These studies have been financed by the Scientific Research Committee of the U P Government

[1] Tiwary N K SCIENCE AND CULTURE *13* 390, 1948
[2] Baker John R. Cytological Technique P 38 1945
[3] Kodani M *Jour Heredity 32*, 147 1941
[4] Tiwary N K *Proc Ind. Sc. Cong*, Pt. 3 81, 1945

ON THE EXISTENCE OF ROSSI SECOND AND THIRD MAXIMUM AND THE ANOMALOUS ABSORPTION OF PHOTONS

Since the report of a Rossi second maximum of cosmic rays by Schmeiser and Bothe[1] at about 17cm of lead, there has been considerable controversy over its existence. It appears that this maximum is observed when the experimental arrangement is more favourable for detecting softer radiations of low intensity A slight effect of the dimension of the absorber may be due to obliquely incident cosmic rays Recently Clay[2] claimed to have definitely established its existence at about 16 cm of lead which he believes to be due to Knock on electrons by mesons But the author[3] found some anomalies in the absorption of RaC gamma rays in lead The intensity was measured with a Geiger Muller counter In preliminary experiments to investigate the nature of secondary radiation, the counter was unshielded and placed at certain distances away from the source, the absorption coefficient between 16 and 17 cm and 19 and 20 cm was found to be appreciably below the theoretical minimum value A search in earlier investigations shows that Soddy and others[4] actually obtained a hump in the log intensity curve exactly where Rossi second maximum is obtained They interpreted this to be due to some peculiar radiations generated in lead which manifest themselves in this locality and those could be eliminated by bringing the electroscope very near the top absorber

Again the author carefully measured the absorption coefficient of RaC gamma-rays between 19 and 27cm of lead with the counter shielded with one cm of lead and placed vertically at a distance 45 cm away from the the source The absorption coefficient between 19 and 20 cm was in agreement with theory but between 22 and 24 cm it was far below the theoretical minimum value and there was a rise again between 24 and 27 cm Starting from 19 06 as origin, the experimental data between 19 and 27cm follows the absorption law approximately represented by the Polynomial

$$I = I_0 e^{-(1)(5763x - 05718x^2 + 0047x^3)} \qquad (1)$$

If μ is the absorption coefficient

$$\int \mu\, dx = 5763x - 05718x^2 + 0047x^3$$

$$\text{or } \mu = 5763 - 11436x + 0141x^2 \qquad (2)$$

There is a point of inflexion at 23 11cm given by $\frac{d\mu}{dx} = 0$, where the absorption coefficient *e g* 3445 cm ^{1} is minimum The values of absorption coefficient calculated from (2) are given in the table below

TABLE

Thickness of Pb absorber in cm	20 33	22 23	23 1	24 77	27 3
Absorption coefficient in cm ^{1}	4538	3555	3445	3832	5929

But by ionisation measurement Mohr and Stafford[5] and more recently Clay (*loc cit*) have reported a third maximum of cosmic rays between 20 and 24 cm of lead This again corresponds to the region of minimum absorption coefficient of RaC gamma-rays stated above

From these correspondences it is very likely that the Rossi second and third maximum and the anomalous absorption of photon have the same origin and may be either due to two groups of short lived neutral particles of low mass or due to multiple scattering of photons It seems to the author that the former is the more probable cause and these may be either directly produced by photons or indirectly by a positron-electron dipole behaving as a neutral particle before annihilation The author about a year before pointed out the importance of photons below critical energy on the experiments with penetrating cosmic rays and large penetrating showers it is usually assumed that any cosmic rays detected under about 15cm of lead absorber is only either due to mesons directly or indirectly or due to some heavier electrons This is an unwarrantable assumption as effects are noticeable through about 27cm lead with even photons of maximum energy only 2 4 Mev as emitted by RaC Now Greisen and others[6] have also shown the importance of photons below critical energy in such investigations

The author is thankful to Mr P Ghosh for his kind help in fitting the curve

P K SEN CHAUDHURY

Bose Research Institute
Calcutta, 1 6 1949

Schmeiser K and Bothe W *Naturwiss 25* 669 1937
[2] Clay J *Rev Mod Phys 21* 82 1949
[3] Sen Chaudhury P K *Ind J Phy 22* 106 and 341 1948
[4] Soddy and others *Phil Mag 19* 725 1910 (Pl 12 Fig 10)
[5] Mohr and Stafford *Proc Roy Soc A 183* 54 1944
[6] Greisen *Phy Rev 75* 1071 and 1063 1949

BOOK REVIEWS

Theory of Propellers—By Theodore Theodorsen Ph D , McGraw Hill Book Co , London and New York Cloth 6"×9", pp viii+164 1948, Price $3 50

In a paper published in the *Transactions of the Institute of Naval Architects* (Vol 6, 1865 pp 13 39) William Rankin first sowed the seeds of the propeller theory His work underwent a gradual development through the hands of Froude, Lanchester, Drazewiecki, Prandtl, Karman, Betz, and Goldstein The complete solution by Goldstein of the potential flow problem for a highly loaded single rotation propeller of small advance ratio formed the greatest single step in the evolution of the propeller theory from the classic axial momentum theory of Rankin and the simple blade element theory of Froude Since this development in 1929, a number of contributions were made by Glaueret, Bairstow, Lock, Theodorsen, and others The accumulated work of Dr Theodorsen for the National Advisory Committee for Aeronautics, Washington, forms the bases of this book, and represents a truly classic contribution towards this highly complicated subject of propeller research

Throughout the text the main emphasis is focussed on the propeller wake infinitely far behind the propeller, and several new parameters are introduced to define this wake Beginning with a general introduction, the subjects treated are, study of the conditions for obtaining optimum loading, a review of Goldstein's boundary problem for single rotation propellers for heavy loading and the derivation of new expressions for ideal thrust, torque and efficiency Herein the author brings forth a new conception of "mass coefficient" which forms the basic parameter of propeller theory It is visualised as the ratio of the cross sectional area of a pure axial jet to that of the propeller in question, the jet having the same thrust and efficiency as the propeller After introducing this mass coefficient ' methods of obtaining it experimentally by the use of electrical analogy of potential flow are described, and the application of theory to actual design problems given, with brief discussions of special effects such as cavitation, compressibility, and dead water There is also a discussion on the problems of slipstream contraction, propeller selection, including conventional parameters and contour charts, and body interference on the propeller The elementary principles of fluid dynamics as related to the propeller theory is discussed in Appendix I, the actuator disk representation described in Appendix II, and a list of standard symbols given in Appendix III In addition there is a good bibliography, and many useful tables and graphs, the latter including those of circulation function and mass coefficient for single and dual propellers with two to six blades This book is the first to give full attention to the recent advances in aerodynamic theory, and to obtain an exact treatment of the propeller theory from the Prandtl concepts of the surface of discontinuity and the resulting induced flow field The experimental technique of simulating the rigid vortex system of the propeller wake for an ideal dual rotation propeller by means of celluloid models having helicoidal surfaces is described by the author, who bases his conclusions on his original work done in 1944 In this connection the reviewer would like to point out that the validity of the electrical analogy, though apparently in harmony with the theoretical concepts for single-rotation propellers, is not completely established for dual rotation propellers The radial lines of intersection of the sets of oppositely spiraling vortex sheets represent regions of discontinuity There is thus no guarantee that the application of the electrical analogy with celluloid models of dual propeller wakes truly represents the operation of actual dual rotation air propellers especially in the practical case in which the dual units operate in tandem rather than in the same plane

On the actual theory of dual rotation propellers, the author maintains that it is likely to be over idealised if not taken and studied in its true perspective In fact the ideal distribution of circulation cannot be obtained in practice by any known means at present, because the theory demands a cyclic change in the circulation function which in turn requires a cyclic change in blade angle The required cyclic pitch change is different for each radial station and therefore cannnot be obtained by a simple oscillation of a blade in its hub As a former Chief of the Division of Physics, National Advisory Committee for Aeronautics, and now Vice President of the Inst of Technical Aeronautics, and Dean of the School of Aero Eng, Rio de Janeiro Brazil Dr Theodorsen has rendered a unique service to aeronautical engineers by bringing out this book and laying before the profession a stimulating and uniquely bold and original contribution, towards the theory of propellers

The book, which forms one of the McGraw Hill publications in Aeronautical Science written under the general editorship of Dr Jerome C Hunsaker, Head of the Department of Aeronautical Engineering, Massachusetts Inst of Technology fulfils a very worthy purpose and forms a valuable addition to the comparatively meagre literature on this advanced phase of propeller research

S K G

Schweizer Holzhauser Aus Den Jahren 1920-1940—By Paul Artaria B Wepf & Co, Eisengasse 5 Verlag Basel, Switzerland, Cloth bound, 6¾" × 9¼", 127 pp 1947, (Swiss Francs 10)

Historians trace the origin of Switzerland to 13th century thereby showing this mountain republic to be one of the oldest countries of the world Old in its origin, but quite modern in its outlook, Switzerland today contains a greater diversity of culture in relation to its geographical area than any other country in the world This culture is nowhere better exemplified than in its beautiful architecture, so harmoniously balanced with its natural science background It is this theme which forms the bases of the book and serves as a good pictorial introduction to Swiss architecture Originally published in 1942, the present volume forms the third edition Its publication date also coincided with the London exhibition of Swiss architecture as well as the first international congress of architects held in London since the war,—a congress in which no nation was more closely identified as regards the exchange of ideas internationally than Switzerland The text deals with single family dwellings and cover a period of development of twenty years from 1920-1940. A few pages describing the regional architectural antecedents of the country, form the bulk of the text All the remaining 100 pages contain plans and photographs of actual structures, so that a reader not well versed in German can even go through this book with benefit To an architect, the most important thing in this work is a statement, at the end, containing a cost appraisal of all the buildings shown in the book The cost is based on Sw Fr/m³ Working these out at the current rates, the reviewer found that the maximum rate was in the neighbourhood of Rs 1/12/ per cubic foot, and the minimum Rs /11/ per cft Most of the dwellings however lay somewhere in between with an average of Rs 1/4/ per cft, i e about As /2/ to as /4/ per cft more than the average rate for this country The overall design standard is very high in Switzerland and the problems of heat insulation leave nothing unsolved However to a person accustomed to the luxury of American sanitary facilities, these Swiss dwellings appear a little orthodox, though quite in line with any other European dwelling house It is a pity that the author has restricted his scope and omitted to show the design of city houses for the latter *together with other public building like hospitals and churches* also form one of most artistic treasures of that country Swiss architecture clearly reflects the influence of German ideas, because in the last twenty years most Swiss architects have had their training at famous centres like Munich, Stuttgart, Karlsruhe and Charlottenburg in addition to their own schools at Lausanne and Geneva

The assemblage of over 100 photographs, 150 plans and a small bibliography, render this volume a beautiful pictorial presentation of Swiss architecture replete with the overwhelming fastidious regard for quality and technique,—characterizing the whole artistic and architectural expression of this cultured mountain race

S K G

Flora Malesiana—General Editor Dr C G G J Van Steenis Published under the auspices of the Botanic Gardens, Buitenzorg 1948 This work is available from the publisher Messrs Noordhoff Kolff N V, Batavia or from Messrs Chronica Botanica Co, Waltham 54, Mass, U S A

We are in receipt of the first part of volume No 4 of the *Flora Malesiana* This is a long range work on the botany and plant life of the Malay Peninsula, Sumatra, Java, Borneo, the Philippines and the island of New Guinea An examination of this part shows that the work has been well planned and co-operation of specialist botanists from the various parts of the world has been secured Besides the actual part of volume 4, this number contains sample treatments of the first three volumes dealing with Malaysian Plant Geography, Malaysian Plant life and a very useful cyclopaedia of Malaysian botanical collectors The present series would deal with *Spermatophyta* and there is a plan to have other series on *Thallophyta*, *Bryophyta* and *Pteridophyta*

The plant-life of South-East Asia has attracted the attention of man for several centuries It has contributed largely to the economical wealth of these islands Often strange stories have been told about peculiar plants of the tropics The so-called deadly "*Upas* tree" (*Antiaris toxicaria*), the largest flower in the world (*Rafflesia arnoldii*) and a large number of insectivorous plant (species of *Nepenthes* and *Drosera*) are found in this area Some of the interesting plant formations and plant types are also found here All these add to our interest, besides a number of commercial products such as timber, rubber, quinine, sugar and various spices The vegetable wealth and the general vegetable covering of these islands were explored by various European and American botanists and we are familiar with such names as Rumphius, Blanco, Miquel Blume, Koorders, Valenton, Robinson, Ridley, Merrill and Burkill There are a number of other botanists as well who operated in this field All these botanists have worked on limited areas and their works are very valuable for those particular areas The present work is planned on a much larger area, and may have to include 25,000 to 30,000 species of higher plants Although this is a huge number, and may take several years to complete, there is no doubt that in view of similar ecological and phytogeographical interest the value of the present work would be immense

We must congratulate the Netherlands Government and Dr Van Steenis for the admirable way they have started this work and we would look forward with much interest to see further numbers of the series We strongly recommend the work to all botanical and other institutes interested in the cultural advancement of the people of South Eastern Asia to the South West Pacific region'

D C

Physics Principles and Applications— By Henry Margenau, William W Watson, and Carol G Montgomery First Edition, 1949 Page VII+759 Publishers McGraw Hill Book Company, Inc Price $ 5 00

The authors of the present book are well known for their efficiency in teaching and experience in Physical research The book under review is a result of their collaboration in a sophomore course in physics at the Yale University, a course, which according to the authors, is aimed to equip engineering students and majors in natural sciences with sufficient basic knowledge of physics to serve as a foundation stone for further work in the various exact sciences and technologies

Between the covers of the volume the authors have presented an account of physics both classical and modern, which is at once rigorous, vital and novel in the manner of presentation

The book comprises, 50 Chapters followed by 7 Appendices, an Index and an Index of Tables The first 14 chapters deal with some selected topics in the fundamentals of statics and dynamics Principles are developed at the outset and as the work proceeds, calculus is more and more injected in the mathematical formalism in a carefully graduated dosage Illustrations in statics and dynamics are highly interesting and can never fail to drive home the principles which they are meant to enlighten

In the subsequent 36 chapters are described intermolecular forces, change of state, kinetic theory of gases, Laws of Thermodynamics, Meteorology, different aspects of electrostatics and electrodynamics, Magnetic properties of matter, Alternating currents, Electronics, Wave motion, Various optical phenomena, corpuscular as well as undulatory, Radiant energy, Atomic structure and Nuclear Physics

While nothing important from the standpoint of historical development of the topics described in these chapters has been left out, the following seem to give an additional merit to the book in comparison with others of the same standard rubberlike elasticity, jet propulsion, meteorology, the heat pump, mechanical impedance, Kepler's Laws of Planetary Motion, man made satellites, atomic structure, the betatron, complete treatment of vacuum tubes, iconoscopes, radar, nuclear reactions, Compton effect, proof of the mass energy equivalence, modern treatment of colour, non reflecting films, and the electron microscope

Throughout the book the presentation has been enlivened by the insertion of important historical notes and the applications of physical principles to other fields

The insertion as Appendices of Units, Values of important General Physical Constants, Conversion Table of Electrical Units, Greek Alphabet, Useful Mathematical Formulae, Natural Trigonometric Functions, Logarithms and a comprehensive Index has increased the usefulness of the book Paper, printing, diagram, and general get up are excellent

Though primarily meant as an introductory course in physics for Engineering students in America, the book can be profitably used by B Sc Pass Course students of any Indian University

R D

English Naturalist From Neckam To Ray—By Charles E Raven, D D Pp x+379 Cambridge (England) At the University Press (Agent for India Macmillan & Co Ltd) Price 30s net

Study of the history and process of emergence of the modern outlook on science has considerable value to intending science students in that it affords an opportunity to new entrants in the field to see for themselves how greatly then current ideas and beliefs in religion and social spheres influenced the judgement of otherwise conscientious, well meaning biologists of the past centuries This will provide a lesson to investigators in natural science to stand guard against falling prey to any dogmas religious or otherwise, and will serve as a guide to confine cnclusions based on critically observed facts Dr Raven has rightly observed that

> in Man's attitude to living nature the process of a gradual overcoming of superstition and fabulous tradition, and the development of modern scientific spirit as a result, is significant and may be followed from man to man. Little by little nonsense was recognized, fables were exploded, superstitions were unmasked and the *world outlook* built up *out of these elements fell to* pieces

Dr C E Raven has established his reputation as a biographer by his remarkable work on John Ray (published in 1942) The volume under review here is the another equally learned biographical work on the earlier English naturalists—botanists and zoologists in particular Dr Raven has shown great skill in gleaning materials for the present volume from little known sources and has contributed much to our knowledge about such naturalists as William Turner John Cairus, Thomas Penny, Thomas Mouffet, John Gerard Edward Topsell, John Parkinson, Thomas Johnson William How, and Christopher Merret—many of whom are not widely known outside of their home country Of the biographies treated in the book, William Turner's appear to be most successful

But it must be pointed out here that Dr Raven has often been too lengthy in his documentation to help maintain the interest of non British readers of whom such details of personalities and theme loose all importance and become tedious to follow Such meticulous details could have been done away without sacrificing the value of the biographies treated in the book Addition at the end of the book of an alphabetic list of author sources and literature consulted would have been a welcome feature

A few minor corrigenda are P 58 Theodore of Gaza's Latin translation of Aristotle's *Historia Animalium*, *De Partibus*, and *De Generatione*, and Theophrastus's *Hortus Plantarum* were first printed at Venice, 1476, and Treviso, 1483 P 145, line 12 "60 feet' should probably be 6 feet P 235, line 8 "John Johnstone' should correctly be spelt as Jan Jonstone

J C S

An Introduction to Biological Science—By D N Ganguly, pp 525+8, Published by Bookland Limited 1 Sankar Ghosh Lane, Calcutta 6 Price Rs 10/ only

This is a book meant to be a text book for the pre-graduation stage of the students of biology in the Universities of India and Pakistan The author of the book is an experienced teacher with first hand knowledge of the intricacies of the subject and the difficulties faced by the beginner As usual with the authors of biology books in India, the first part deals with plants and the second part with the animals This arrangement is forced by the syllabuses presented by the Universities and the type of teaching staff available in the Colleges An ideal text book would be to treat the science of biology as a whole drawing parallel illustrations from plants and animals wherever possible and showing the unity of life processes Incidentally we draw the attention of the University authorities to this unsatisfactory situation caused by the syllabus drawn by themselves

The author has done his best to make the book useful for the teachers and the taught alike although we feel there remains enough scope for improvement The figures in the text are far from satisfactory

It is also regrettable that the date of publication of the book has not been mentioned

A K G

SCIENCE AND CULTURE

A Monthly Journal of Natural and Cultural Sciences

Vol. 15 AUGUST 1949 No. 2

FOOD AND CASH CROPS CRISIS IN INDIA

THE most vital and dominant question, facing the country and agitating the minds of millions of men and women today, is food Insufficient food supply is not altogether a new thing in India But in normal times, with free flow of commodities, un restricted movements and fluid currency position the deficit could be easily, and was actually, made good by importation from abroad Therefore our dependence on imported foodstuff went unnoticed to the lay public The onset of the World War II stopped the normal sources of supply from Burma and other countries of South East Asia and made the country painfully conscious of her acute deficit in food supplies The Bengal Famine of 1942 43, which cost the lives of 1 5 million people and left behind a few more millions sapped of all vitality for the rest of their existence demonstrated the most pitiable shortage of food supply in the country

To help relieve the food shortage in the country and to make her self sufficient in respect of food and fodder crops, the 'Grow More Food campaign was initiated in 1942 by the Central Provincial and State administrations The measures recommended under the "Grow More Food campaign were (1) bringing new land, including fallow land, under cultivation (2) diversion of land from non food to food crops (3) increase in the supply of improved seeds, (4) extended use of manure and chemical fertilizer, and (5) improvement in irrigation by extension of existing irrigation canals, excavation of new and renovation of old ponds sinking of tube wells etc

It is now seven years since the Government have started the "Grow More Food" campaign But, has there been the least sign of progressive improvement in the supply of food commodities in any part of this vast country? Apart from a considerable administrative expenses to maintain the personnel for the campaign on an all-India basis, several hundred millions of rupees have been expended or rather wasted on this campaign For two years, 1943-44 through 1944 45, grants from the Central revenues and the Cotton Fund for the campaign amounted to Rs 26 99 millions and loans for the same period to cultivators to Rs 29 35 millions[1] Figures of expenditure by the Provincial and State Governments are not available, but as these grants are generally made on a 50 50 basis, another Rs 56 34 millions would have been expended by the Provinces and the States Exact statistics of later years are not known but if the press statements attributed to the high officials of the Ministry of Agriculture are to be relied upon the annual expenditure on 'Grow More Food' measures have been of the magnitude of Rs 40 millions from the Centre and an equivalent amount from the Provinces and the States Calculated on the above basis the total expenditure from the public exchequer upto March 1949 would reach an astronomical figure of Rs 400 millions !

But what achievement do we find to the credit of the "Grow More Food" campaign and the brain trust behind it? Instead of gradual improvement in the availability of food crops in the country, we find a progressive deterioration in the supply of food commodities both in quality and quantity, over the whole country

For the year 1937 38 through 1941 42, the average annual importation of cereals to India was 1 38 million tons But despite the operation of the 'Grow More Food' campaign, the figures of importation of food grains for 1948 rose to 2 84 million tons at a cost of Rs 1,295 9 millions To make the imported food grains available to consumers at the statutory fixed prices, Rs 171 2 millions had to be expended by way of Government subsidy Prospect for 1949 is still worse 4 million tons of food grains are the target figures of importation to keep the ration commitments operating This would probably involve draining out of the country's foreign exchanges to the extent of nearly Rs 2,000 millions

---

[1] Famine Enquiry Commission Final Report Manager of Publications (India Government), Delhi. 1945.

This is the present position, and the future prospects of the situation in the food supplies of the country are still worse

Meanwhile, responsible high officials of the Ministry of Food and Agriculture are indulging in loose talks and statements and in doubtful promises to make the country self sufficient in respect of food commodities by the end of the year of grace, 1951

In January 1947, Dr Rajendra Prasad, the Food Minister, first set the target of achieving self sufficiency in food by the end of 1951 At that time annual deficit was thought to be of 1 5 million tons and he had 5 years in hand to do the job We now know the hard fact that the present annual deficit is 4 million tons Possibly the actual deficit is higher still as persistent complaints are heard from the Provincial and State Governments that the Central food allotments are not enough to supplement their actual needs on a reasonable rationing basis Even accepting the most conservative estimate of 4 million tons as our yearly deficit and adding one million tons of food grains a year to take care of the annual increase of population, the minimum figure of food deficit in the Indian Union by the end of the year 1951 would not be less than 6 million tons

Last March, two years after Dr Rajendra Prasad's proposal, Food and Agriculture Minister, Sri Jairamdas Daulatram, proclaimed in the Indian Parliament to achieve in two and a half years what Dr Rajendra Prasad proposed to achieve within 5 years then on hand

We do not know of the concrete measures and steps being undertaken to reach that promised goal We of course no longer hear of Grow More Food" campaign, though that costly failure has not been publicly admitted, it has nevertheless been silently conceded to We now hear of (*i*) intensive cultivation of permanently irrigated areas, (*ii*) sinking of tube wells, excavation of wells and renovation of ponds to extend farm irrigation, (*iii*) diversion of land from non food to food grains (*iv*) distribution of improved seeds, (*v*) reclamation by 1951 of 800,000 acres of new land, and (*vi*) increased importation and distribution of fertilizers at subsidized rates

A recent estimation[1] puts the requirement of ammonium sulphate alone at 1 5 million tons for the next 4 years beginning from 1948 49 This will require an expenditure of Rs 715 7 millions—Rs 152 2 millions in dollars, Rs 304 6 millions in sterling and the balance of Rs 258 9 millions in Indian currency With the recent official announcement of India's critical foreign exchange position, the importation of chemical fertilizers on such huge quantities seems unlikely The Government have already indirectly indicated this by advising the use of compost In the past, the Government s attention to the advisability of using compost has been repeatedly drawn, but without much effect, and now they have all of a sudden become compost minded It has been stated that under the Town Refuse Composting Scheme the annual production of composts should be raised from its present level of 6,00,000 tons to that of 15,00,000 tons before March 31, 1950* In fact, we are now being told that 10 million tons of good quality compost can be obtained by the proper utilization of refuse materials from 4,000 towns and cities of the Indian Union But not even one dozen of towns are known where comprehensive operations are in progress for the utilization of town refuse for manurial purposes nor is it known how this is to be distributed to the cultivators in the remote villages?

Reclamation and irrigation through power plants are magic words to delude the ignorant masses Reclamation is no doubt a great necessity under the present circumstances But reclamation is not always crowned with success in the very first years Reclaimed land needs scientific handling, adequate doses of balanced manure and fertilizer, and careful weeding operations for the first few years for the land to be really productive Merely breaking up of new land will not by itself serve in the least the purpose of increasing food production Even then it is really doubtful if India has at present the required power equipment to reclaim the proposed target of 800,000 acres of land before the 1951 crop season starts

A more realistic figure capable of achievement is given in a recent publication[2] by the West Bengal Government, who have set their own target of reclamation at 2,000 acres for 1948 49 and another 9,000 acres for 1949 50 The most ambitious land reclamation scheme now in progress in the whole of India is the Meerut district scheme in the United Provinces It is reported that 20,000 acres have already been reclaimed of which 18,000 are cultivable, and it is hoped to do another 40,000 acres during 1949 50 Taking the average of the figures for these two provinces, and considering that several provinces and states are without any such scheme whatsoever, not more than 400,000 acres are likely to be reclaimed and made productive by the end of 1951

Given suitable condition of cultivation, and use of improved seed it is likely to raise the yield by 5 to 7 per cent Distribution of improved seed presupposes its production under competent agencies Though we hear so often of adequate distribution of improved seed since the inception of the "Grow More Food" campaign, we find the complete absence of large scale undertakings of seed farms in the provinces or under the central auspices Will purchasing from open market of seed of doubtful quality, purity and viability and its distribution at subsidized rates help the purpose of increased yield through "improved seeds"?

---

[1] Agricultural Situation In India, Vol 3, No. 11, February, 1949, p 31 Issued by the Economic and Statistical Adviser, Ministry of Agriculture, Government of India.

* The Government of India appointed a Central Compost Development Committee with 23 members on the recommendations of Central Manure (Compost) Development Committee which held its second meeting at Jaipur on December 16-17, 1948.

[2] Prospectus for Agriculture in West Bengal, Government Press, (Alipore) Calcutta. 1949.

Lastly, on the question of diversion of land from non food to food grains production, it is very doubtful if any land can be released from under their respective acreages Rather, persistent efforts are being made to find additional acreages for several cash crops * Even if such a release could be possible, how will the cultivators be persuaded to change over, say, from growing sugarcane to rice or wheat? Indeed, there appears to be nothing specific about this neo scheme (or wish!) of achieving self sufficiency in respect of food grains in the Indian Union, except a date

Instead of promising bread and honey enough for 330 millions of Indians by the end of 1951, the Government would have shown prudence and practical wisdom had they first analyzed impartially the causes of the failure of the multi million rupees scheme of "Grow More Food" campaign, made safeguards to avoid those pit falls, removed from authorities those responsible for such colossal mismanagement, and taken the public in confidence with regard to their new plan for achieving self sufficiency in food A less ambitious scheme amenable of sure execution, could have inspired confidence among the masses The statement of Mr Norris E Dodd, Director General of FAO, reported to have been given at Washington, D C, after his return from official visits to the Eastern countries, that India cannot achieve self sufficiency in food within the next 10 years, may not have been palatable to New Delhi but it certainly was factual Coming as it does from one who is not only the head of FAO, but who was long a top level official of the United States Department of Agriculture, his view should have led our Central Government to seriously reconsider their proposed programme (or wish!) of attaining self sufficiency in food by 1951

Added to the unhappy food situation in the country, the position as regards the important cash crops in the Union is getting worse day by day We would like here to refer our readers to a subsequent article by Dr J C Saha, embodying the present situation and dismal future of the important cash crops of the country According to the recent statement of the Minister of Commerce, Government of India, Rs 660 millions' worth of raw cotton were imported last year from countries other than Pakistan India must have in addition, imported several hundred millions worth of cotton and jute from Pakistan How long can the country withstand such colossal drainage of her foreign exchanges?

A careful, bold and long time planning needs to be undertaken to grow in the country as much as possible of jute and cotton The application of the same programme of work to cash crops as was practised for the last several years under the 'Grow More Food' campaign and now being advocated for the industrial crops will not solve this awful muddling Where is the assurance that the measures which proved so complete a failure in respect of food crops will achieve success in the case of jute, cotton, etc? The position with regard to cotton and jute are more amenable to solution as very well organized private industries are actively interested in the matter If the Government can show wisdom of vision and sincerity of purpose, quicker success can be achieved with respect to these cash crops

Instead of providing doles to primitive, acre farming units, the Government should approach the jute mills and encourage them by all possible means to produce a good percentage of their requirement of raw jute Sugar mills should similarly be approached to undertake cane cultivation A few of the sugar mills have their own cane farms, which supply a portion of their crushing capacity We had once visited a couple of cane farms under a sugar mill The stand of their crop was, as must have been the experience of others, decidedly superior to and higher yielding than the crop in the adjacent fields owned by village farmers and cultivated according to the country old methods The above holds good for cotton as well

Many millions of rupees are being ear marked from the Central and Provincial funds for the increased production of jute and cotton in the Indian Union A considerable share of this amount, if devoted to provide the respective industries with interest free loans for land, capital farm machineries and other similar assistance, will encourage the mills to go ahead to raise a major share of their raw materials on modern scientific methods This will in its turn help to improve the present situation in that the mechanized, modern, large farms would not, and cannot for economic interests of their own, let the land go without a second crop for the rest of the year after jute or cotton is harvested

The idea of industrialization of major commercial crops of the country may appear to some a bit new, but that way lies the only hope of Indian agriculture holding its own and meeting world competition in due course

Returning again to the problem of increased food production in the country, instead of wasting hundreds of millions of rupees of this poor and famished land for propaganda work and maintaining a huge army of fat salaried officers for the same with little or no appreciable effect, the Government might well have been advised to entrust this highly responsible and urgent task to a small body of business like men of proved ability, integrity and experience to take immediate action, as under a state of emergency, for reclaiming as much as possible of the fallow land in the country by sinking tube wells, supplying manures, and high quality or improved seeds Co operative societies with Government subsidies for the purpose might have been started at once under the control of this body Our ryots, peasants or even landlords

---

* See for details the article on Cash Crops following this editorial on p. 46.

cannot be induced by propaganda or "Grow More Food" campaign to launch upon a venture which is not likely to bring immediate or ready return for their labour or money invested It is, therefore, no wonder that all these noises about the Grow More Food ' campaign had failed to move them, and these simply vanished into thin air What was most needed for the country is direct action by a determined body or corporation with resources of the Government behind them It does not require stating that food can never grow by mere propaganda or preaching, nor by the appointment of a host of highly paid officers, nor even by expenditure of huge sums of money in mere planning and scheming Food is not also likely to grow by the spectacular display of ploughing the land in the city parks, or in the spacious lawns of Government houses, nor even if the high dignitaries of the State actually lend their helping hand in driving the plough They may be quite good as an example and inspiration but are of little consequence in the solution of our food problem Food can grow only by action and actual cultivation Even if direct action may fail to yield satisfactory result to begin with, it will certainly pave the way for it in near future Planning for long range and expensive schemes like harnessing of mighty rivers, erection of fertilizer plants, etc , are well and good But they cannot obviously solve our immediate problem or meet the present emergency in respect of our food requirements

It is, however not yet too late to mend, and we hope these suggestions will not fail to attract the notice of the Government in solving the all important problem which affects the very life of the people of this great sub continent *

---

*While sending the above to the press we were glad to find a *communique* by the Government of India vesting the newly appointed Food Commissioner Sri R K Patil, with special and extraordinary powers To assist him in the implementation of the Government s programme of self-sufficiency in food a Special Food Production Board has been formed consisting of the Food Commissioner (*Chairman*) the Director of Intensive Cultivation the Director of Land Reclamation the Director of Irrigation a representative of (1) the Ministry of Transport, (2) Ministry of Industry Economic and Statistical Adviser to the Ministry of Agriculture and the Financial Adviser attached to the Ministry of Agriculture We shall be awaiting with interest and hope the activity of this Board

---

NEED OF INDUSTRIALIZATION OF PRINCIPAL COMMERCIAL CROPS OF INDIA

J C SAHA

To the critical shortage of foodgrains through which the country is passing since 1942, has been added another problem, *viz* , the acute shortage in the supply of several important commercial crops—cotton, jute, etc , consequent to the political partition of India into two independent states

JUTE

In the pre partition days jute used to be grown mainly in East Bengal, which now comprises the eastern part of Pakistan All the jute mills, on the other hand, are located around Calcutta, in the Indian Union At the end of 1947, jute was grown on 6 5 lakhs acres of land in the Indian Union and 1 7 million bales (of 400lb each) of jute fibre were produced The corresponding figures of acreage and yield in Pakistan for the same year was 6 8 million and 2 million respectively Thus the Indian Union produces about 20 per cent of the combined output of India before the partition The present annual requirement of the Indian Union is estimated to be 6 million bales of jute fibre Of these, jute mills consume 5 5 millon bales of jute fibre for manufacture of hessians, gunny bags and other jute manufactures, while the remaining 5 lakhs bales are used for domestic non mill purposes Out of the 5 5 million bales of mill consumption, manufactured goods equivalent to 4 2 million bales are exported to foreign countries

Indian Union has therefore to depend on Pakistan for the importation of 4 3 million bales of jute to feed her jute mills and to meet her domestic non mill consumption Pakistan Government have already levied a heavy duty on the export of jute to Indian Union and imposed a further restriction as to the quality of jute allowed to go outside her borders The Indian Union is therefore faced with a grave situation, that of having to curtail the working of the jute mills or may even lead to the partial closure of many mills On the other hand, it will involve a loss of many millions of rupees in dollars and other hard currencies, earned by export of jute manufactures, at a time when her need for adequate foreign exhanges is all the greater to pay for increased importation of foodgrains and machineries for nation building purposes It is a hopeful sign that our National Government has become fully conscious of the situation and is devising measures to increase jute production with the aim of becoming self supporting, should Pakistan ever impose a total embargo on the exportation of jute to India *

---

*We had occasion to discuss the future of jute in our editorial entitled 'National Fibre Research Institute in India' (See SCIENCE AND CULTURE, *13*, 79 194) Ed *Sci & Cul*

COTTON

Almost identical is the situation with regard to cotton Cotton is mostly grown in the West Punjab and Sind provinces of Pakistan while majority of the cotton mills are located in the Indian Union According to 1947 48 figures Indian Union produces only 3 2 million bales (of 400℔ each) of cotton her requirements being 5 4 million bales Therefore the country is deficit to the extent of 2 2 million bales of cotton a year Because of the partition of the country there has recently been a marked deterioration in the supply of cotton in the Indian Union so as to threaten a number of textile mills in the Union with an almost partial curtailment of production But any shrinkage in the turn over of the Indian mills will entail a reduction in the country s export of manufactured textiles giving rise to complications in foreign trade balances Manufactured cotton goods from Indian Union have been a great tool in securing in exchange foodgrains from the South East Asian countries As such Indian Union can ill afford to curtail production of cotton maufactures

SUGARCANE

Another principal commercial crop in the Indian Union is sugarcane Here the situation is not as bad as with jute or cotton The country is just self sufficient in production of cane But because of low average production of around 15 tons of cane per acre an unusually large area of over 3 7 million acres have had to be planted under sugarcane at a moment when greatest economy should be observed in the use of available cultivated land †

GROUNDNUT

Groundnut is another valuable cash crop in Indian agriculture and is useful in several ways The kernels are used mainly for the extraction of edible oil which is in great demand here and abroad for the manufacture of margerine (or *Vanaspati ghee*) The cake left over after oil extraction is rich in nitrogen content and is valuable either as manure or livestock feed Apart from uses as human food or cattle feed cultivation of groundnut as a rotation crop to restore to the soil the depleted nitrogen deserves further encouragement

The production of groundnut in India in 1941 42 averaged nearly 3 million tons of nuts on 7 million acres of land The average production per acre is 900 ℔s Compared with many other countries the Indian yield per acre is very low indeed

COMMERCIAL CROPS *vs* FOODGRAIN CROPS

An official investigation was recently undertaken at the instance of the Indian Cabinet into the possibility of diversion of land from commercial crops to food crops to reduce as much of the prevailing foodgrains deficit as possible The result of the investigation is far from encouraging and has shown little possibility of such land diversion

An increase in the acreage under foodgrains at the cost of cotton would generally amount to what would be saved by lesser import of foodgrains would be spent on larger import of cotton from abroad

So far as jute is concerned there can be no question of release of land from its present acreage On the contrary every effort is being made and rightly so to find additional acreage and suitable areas for extension of jute cultivation

As regards groundnut enough data are not available to make precise statement but in view of the great demand in the country for *Vanaspati* (vegetable *ghee*) as a cooking medium no curtailment of its acreage can be contemplated without jeopardizing the kitchen front Furthermore groundnut has been a good foreign exchange earner in the Indian economy for the past several years In the year 1947 48 over Rs 30 millions were earned by the export of nearly 46 thousand tons of groundnut

Sugarcane was once considered to have some ground to yield and it was at one time thought that the 10 per cent of the present sugarcane acreage could be diverted to foodgrains * But it is now admitted to be a doubtful proposition in consideration of the fact that sugar production has not yet reached a level enough to meet the full domestic demand and supply commitments to foreign countries

It therefore becomes evident that release of land from under any one of the above major commercial crops is impossible at the moment in fact each of them is in greater demand than their supply position is able to meet the internal consumption and to satisfy demands from abroad as a means to earning much needed foreign exchanges Such demands for increased production can be met either by extending the acreage under their respective cultivation which is not possible beyond a certain limit or through the application of technological knowledge to increase production per acre basis it is in the latter that lies the greatest hope for the future

PRESENT MEASURES TO INCREASE PRODUCTION OF COMMERCIAL CROPS

The current attempts to increase production of commercial crops in the Indian Union include (*i*) bringing new land including fallow land under cultivation (*ii*) extended use of manure and fertilizer and (*iii*) increase in the supply of improved seeds These have been the lines on which the Grow More Food campaign was conducted since its inception in 1942 The fate that the Grow More Food campaign has met should lead us to think over again whether the measures that have proved so complete and so costly failure with food crops can be expected to achieve any better results with respect to jute, cotton, etc

---

†The future of the sugar industry was discussed in details in an article entitled Sugarcane and Sugar Industry in India published earlier (See SCIENCE AND CULTURE 12 466 1947) Ed Sci & Cul

* Decision arrived at the conference ended April 17 1949 of Secretaries and Directors of Agriculture of the Provinces and the Centre

Reclamation of cultivable waste land requires adequate supplies of heavy tractors and similar equipments and enough supplies of trained hands to operate them, if reclamation of land is to be done on a scale large enough to cause appreciable increase in the production of the commodity concerned This cannot be left to the millions of acre farmers to do it for themselves Either the State is to embark upon an unprecedented magnitude of large scale operation involving many thousands of tractors, or the State should invite the co operation of the industries in related commercial crops and induce them, through free technical advice or financial subsidy, to grow at least a substantial part of their mills, requirements

In the situation that our fields are fertilizer starved proper application of manure and fertilizer can reasonably be expected to increase the yield of jute, cotton sugarcane, etc , by 15 to 20 per cent However, the available supply of fertilizer is very limited During the year ending March 31, 1949, about 1 5 lakh tons of chemical fertilizer have been imported at a cost of about Rs 45 millions The share alloted to jute cotton groundnut and sugarcane will hardly exceed 6 000 to 8,000 tons for each of these crops, i e it means there is 1 ton of fertilizer available for 400 to 500 acres of land under any of these commercial crops

There is no reliable information available as to the acreage under improved seeds Cotton was known to have over 56 per cent of land under improved seeds but with the partition the situation has considerably changed as most of the land under improved strains has gone over to the Western Pakistan As regards jute it is known that the Government Jute Seed Agent, Bengal (through whom alone certified improved jute seeds were so long sold) sold in 1946 a small quantity enough to sow only 3 000 acres Even assuming that the cultivators retained some improved seed of their own it may reasonably be assumed that only an infinitely small percentage of jute land are under improved strains of seeds As such the availability of improved jute seeds for distribution is far too inadequate[1]

The principal agencies for the multiplication of improved seeds are the agricultural departments and the central commodity stations Because of the absence yet of large scale seed raising farms under any of the above agencies the rapid expansion in the quantity of improved strains of seeds available for distribution offers difficulty

Competition from Abroad

It may sound strange that the fate of our important commercial crops hangs in the balance in the face of competition from foreign countries It may seem paradoxical that there can be fear of competition when there is actually a shortage of supply of the commodity in question in the domestic market The case of sugar industry will well illustrate the point Because of the application of improved technological methods of production in the field and in the factory, the cost of production of cane and sugar in Java and some South American countries is much lower compared with that in India Even in the face of high import tariff the Java produce is almost about ready to re enter the Indian markets in price competition Indian sugar is according to recent press reports losing the United Kingdom markets

Technological Advancement in Production Methods Abroad

One of the biggest factor in the cost of production of agricultural commodities is the wages of human labour employed Any measures that are likely to save manual labour will greatly help cut down cost of production It is estimated[2] that rapid farm mechanization in U S A during the World War II years accounted for 30 per cent of the rise in production per manhour of farm labour Increased yield of crops equalled farm mechanization as a labour saver per unit of production during that period Increased mechanization contributed to a rise in crop yield, in part because it facilitated greater timeliness in crop operations and thus saved losses from weather hazards It has been calculated that increased farm mechanization during the past several years has released in U S A , 15 million acres of crop land from the production of feed for work animals to the production of food crops for human consumption

Further revolutionary method of production has been achieved within the past 12 months in the United States A mechanical cotton picker has been perfected and is now on the market there that will pick up a 400 lbs bale in 60 minutes—40 to 50 times faster than hand picking Mechanical harvesting of cotton will save Rs 50 to Rs 70 per bale of cotton i e , a saving of Rs 10 to Rs 15 per maund of cotton A mechanical picker will help save considerable time and prevent weather hazards in that it can clean an acre of cotton field in one hour and fifteen minutes

The United States cotton production for the year 1947 48 was over 15 million bales (i e , 47 per cent of world production), while her domestic mill requirement was around 10 million bales She has had therefore an exportable surplus of 5 million bales of cotton Already the prices of American cotton is lower than cotton produced elsewhere With still lower cost of production by Rs 50 to Rs 70 per bale due to the use of mechanical cotton pickers, should there be any surprise if in near future the American cotton dump the Indian market? Only the present scarcity of dollar exchange is postponing such a thing to happen

---

[1] (Indian Central Jute Committee), *Jute Bulletin*, Vol 10 No. 10, January, 1948.

[2] Report of the U S Secretary of Agriculture, 1949 U S. Government Printing Office, Washington, D C, 1949

Export of groundnut to several western countries has been a good earner of foreign exchanges During the fiscal year 1947 48, over Rs 30 millions were earned by exporting nearly 46 thousand tons of groundnut. But here also there appears to be cloud in the horizon American agricultural engineers have very recently perfected a machine that will shell 300 lbs of groundnut an hour Previously a man required one hour to turn out one pound of shelled nuts The United States produces a considerable quantity of groundnut in her Southern States Will there be any wonder if in the course of next few years India looses the European export market in price competition with U S A

With respect to jute, the position may not be as bad because attempts to grow jute overseas have not met with success But, because of high prices of raw jute, and so of jute manufactures several countries are beginning to use substitutes of jute goods for several purposes The writer has seen almost universal use in the United States of meshed cotton sacks for packing of potatoes, cloth (cotton) bags for quantity packing of flour and other wheat products, and strong craft paper reinforced with cotton yarn for packing and bagging of lesser quantity Strong paper bags are being increasingly used in bagging of cement in Europe as well

INDUSTRIALIZATION OF METHODS OF PRODUCTION ONLY SOLUTION

It will be apparent from the above account that the principal cash crops of India are heading towards a major crisis in world perspective, if foreign exchanges are to be earned by their export The agricultural authorities in the country do not appear to be conscious of this growing tragic situation due to their preoccupation with food production measures and partly through probable ignorance of the most recent development in the technological methods of production in the advanced countries

Unless the challenge is taken up at once and methods are devised forthwith, the Indian agriculture is doomed for ever We can no longer rely on the century old, primitive method of agriculture to attain the goal of increased production and face world competition Even the present State help by way of subsidized distribution of available short supply of fertilizers and improved (?) seeds is not expected to succeed in case of cash crops when it proved such a costly failure with respect to foodgrain crops

The only way by which Indian agriculture can stand up to foreign competition is through rapid industrialization of agriculture Instead of dissipating crores and crores of rupees every year by way of doles to millions of primitive acre farmers, the State should encourage and actively help the establishment of large scale modern farming as they are now doing in respect of new or important industries of India The State should provide assistance in the procurement of suitable land now lying uncultivated and heavy agricultural machineries and loan of technical personnel, and, if need be, by subscribing liberally to the share capital of farming corporations or by providing a guarantee of certain minimum profit on private capital investment or by exempting the farming corporations from income tax and/or land revenue for the first few years By necessity large farming units will have to employ modern wage saving agricultural machineries, mechanical harvesters and power sprayers By necessity the large farms will have to employ trained agricultural graduates, whose technical knowledge will thus be usefully utilized in creating wealth in the country Any fertilizer supplied to such modern farms are likely to produce the desired results as it is then sure to be applied at the proper time when the crop in question is likely to give the best response Such large scale farming units will be able to do their own selection of seeds and do their own breeding of improved varieties of crops and out of sheer motive of profit will offer for sale to the common cultivators their improved brands of seeds and propagating stocks The agricultural departments can then be relieved of several minor duties, apart from advising on technical matters, the agricultural departments can then be able to focus wholehearted attention to researches and investigations of fundamental nature, which is the basis of any technological improvement in production methods and labour saving devices and help make agriculture a welcome occupation

ORGANIZATION OF SCIENTIFIC RESEARCH IN FRANCE

S N SEN

I INTRODUCTION

THE history of the development of scientific research and thinking in France goes as far back as that remarkable intellectual and sociological movement which is generally known as Renaissance Since the end of the twelfth century the intellectual life in France as in other parts of Europe came to be gradually organized around the universities The University of Montpellier was established in 1180 which was soon followed by that of Toulouse (1229) and Paris (1253) The subsequent three centuries witnessed the development of universities at other provincial cities—Grenoble (1339) d Aix Marseille (1409) Besançon (1422) Caen (1431) Poitiers (1432) Bordeaux (1441) Rennes (1461) Lille (1562) Strasbourg (1567) etc —and hence the diffusion of knowledge and learning throughout the country

Although the universities championed this new intellectual movement in France they were not always a healthy influence as far as scientific inquiry was concerned Theology and scholasticism so profoundly dominated all learning that the natural philosophers had difficult times in most universities It is not therefore surprising that the first real encouragement of science came from the State and the Emperors and that its original growth centred around special institutions and establishments completely outside the universities

The most notable example of this is the *College de France* which was established by Francis I in 1530 in an attempt to encourage natural philosophers and original thinkers to teach and investigate in an atmosphere free from theological limitations and medieval scholasticism Originally developed from the practice of appointing Royal Lecturers the College has remained over the centuries a symbol of freedom of thought and inquiry and has exerted the most prodigious influence on the progress of science in France Other important examples of the imperial patronage of science are the *Jardin du Roi* (1627) which was later on reorganized as the present *Museum National d Histoire Naturelle* the Academy of Sciences (1666) and the Observatory of Paris (1667)

This tradition of supporting science was maintained even during the declining years of the Empire in the eighteenth century Thus *Ecole des Mines* (1747) *Ecole du Génie* (1750) *Ecole Militaire* (1752) *Ecole Nationale Veterinaire d Alfort* (1766) *and Ecole Nationale Supérieure des Mines* (1783) represent the last efforts of maintaining a tradition of which Imperial France was rightly proud

The Revolution ushered in yet another period of intense scientific development which culminated in the unquestionable supremacy of French science during the nineteenth century The National Convention set up by Napoleon was responsible for the creation of such fine institutions as *Ecole Normale Supérieure* (1749) *Conservatoire des Arts et Métiers* (1794 98) *Ecole Polytechnique* and *Bureau des Longitudes* which produced a brilliant crop of scientists in all fields of research and investigations

It is not the purpose of the present article to review the fascinating history of the development of science in France This sweeping summary of scientific development over several centuries is only intended to give a rough background of the present efforts to reorganize science along the most productive lines —which is proposed to be discussed in this paper with special reference to the highly commendable work of the *Centre National de la Recherche Scientifique* (CNRS)

II ORGANIZATION OF SCIENTIFIC RESEARCH BEFORE WORLD WAR II

The history of the development of CNRS as a central and governmental organization responsible for the *promotion and co ordination of scientific research* in France records many intermediate efforts great and small during the last forty years It is of great interest to note that in all those efforts a sharp distinction was made between pure and applied research and as such separate machinery was established to promote the cause of each which for many years functioned on parallel lines Not until recently was the fundamental unsoundness of this distinction clearly realized and the establishment of the CNRS really marked the beginning of a new period of co operative development of both pure and applied research under the auspices of one central organization For a fuller appreciation of the work of CNRS it is necessary to know those previous efforts of which a brief account is attempted in the following text

A PURE RESEARCH

Ecole des Hautes Etudes The idea of assisting pure research through government provision of grants in aid was first conceived by the *Ecole des Hautes Etudes* established at the end of the Second Empire This institution primarily responsible for the study of the physical and the natural sciences often used to provide financial aid to scientists engaged in experimental research and badly needing such help for the purchase of equipment This financial aid was limited to a couple of hundred thousand francs and although quite inadequate for the growing needs of research represented the only effort worth mentioning for a long time

Caisse des Recherches Scientifiques At the beginning of the present century (July 1901), the Government established a new Fund for Scientific Research the *Caisse des Recherches Scientifiques* under the Ministry of Education The Caisse des Recherches was a public organization with legal status and financial autonomy and was the first of its kind whose example was later followed in many other connections The Caisse was administered by a Board with the assistance of a Technical Committee divided into a number of sections The grants in aid made available by the Caisse were intended for the purchase of equipment for research in physical and biological sciences and for meeting the cost of printing scientific and other publications of the various learned societies in need of such help For the inadequately equipped laboratories and the starved societies the Caisse was undoubtedly a real and great relief but very soon its limited resources of hardly one million francs created more problems and invited more cirticism than it had hopped to solve and meet Besides the Caisse by its statute was not designed to provide financial help to scientific workers themselves a limitation which proved to be a great defect in the whole conception of the Fund

However for nearly thirty years the Caisse des Recherches Scientifiques continued to be the only public organization giving any consideration however insufficient to the whole question of promoting and subsidizing pure scientific research in France This was a period which witnessed significant and far reaching developments in other countries notably in Great Britain the U S A and the U S S R In Great Britain the Development Fund (1909) the Department of Scientific and Industrial Research (1917) and the Medical Research Council (1920) were established in this period In the United States the National Research Council came into esixtence in 1916 and was placed on a permanent footing in 1919 Similar Scientific Research Councils were also established in Canada and Japan during the same period Finally gigantic efforts were made in the Soviet Union to reorganize the whole structure of scientific research around the Academy of Sciences between the years 1920 and 1930 The governments of these countries voted large sums of money for more intensive development of scientific research under better conditions of co operation and central management

The French scientists were bitterly aware of their government s backwardness and lack of vision with regard to scientific research and development In the previous generation Pasteur and Claude Bernard had repeatedly warned the government of the disastrous results of their policy of parsimony in scientific research and Maurice Barres had written vigorously on the poverty of the laboratories In the inter war period Jean Perrin Emile Borel Madame Curie André Mayer Georges Urbain Jacques Cavalier and many other leading scientists carried out a unified campaign against the government s inertia and never failed to emphasize in their writings and speeches, the poor conditions of research and their deep repercussions on the general national well being

It must be absolutely understood wrote Jean Perrin, that scientific research is our only chance to create really new conditions under which human life will be for everyone freer stronger and richer in possibilities of happiness It therefore seems senseless that various nations have so far made no serious effort to see that those who are talented for such research are not diverted from it by material necessities We have thus lost so many men of genius that our present existence is surely poor and miserable compared to what could have been made possible even today if these researches were developed [1]

Perrin and some of his colleagues at the Institut de Biologie Physico chimique (1926) also prepared a plan for a national service of scientific research acting under the advice of a superior council of research in which they strongly advocated that the expenditure for research should amount to about 1 per cent of the national budget This plan envisaged the recruitment and training of four categories of research workers *viz* research fellows (boursiers de recherches) research assistants (chargés de recherches) research masters (maitres de recherches) and directors of research (directeurs de recherches) It also prosposed the same status and remuneration for these categories of research workers as were enjoyed by demonstrators assistant lecturers lecturers and professors in the teaching profession respectively This was to enable the scientists to concentrate only on scientific research without any other duties or obligations and thus to provide for a new incentive to research

Caisse Nationale des Sciences Perrin s plan was widely discussed among scientific circles government quarters and in the press By 1930 the efforts of the scientists began to bear fruit In June 1930 a new bill to establish a national science fund the *Caisse Nationale des Sciences* was debated in the National Assembly and became law in September of the same year The Fund started with an annual budget of 5 million francs and assumed as its principal function the task of recruiting and supporting a group of research workers under the categories of research fellows research workers, research masters and directors of research as envisaged in Perrin s plan The Fund also provided grants in aid to scientists and their families in straitened circumstances The Fund was worked by a Board of Administration which set up two Scientific Committees each divided into five sections—one dealing with the mathematical and experimental sciences and the other with the social sciences

---

[1] Il faut absolument comprendre que la Recherche scientifique est notre seule chance de créer les conditions vraiment nouvelles ou la vie humaine soit pour tous de plus en plus libre et puissante et riche en possibilités de bonheur Il semble donc insensé que les diverses nations n aient fait jusqu ici aucun effort sérieux pour que ceux qui sont doués pour cette recherche ne s en trouvent pas écartés par des nécessités materielles Nous avons ainsi perdu tant d hommes de génie que notre existence actuelle est certainement pauvre et misérable à côté de celle que nous ménerions aujourd hui meme si ces chercheurs avaient pu se developper —(*Almanach des Sciences* 1948)

Conseil Supérieur de la Recherche Scientifique Thus in 1930 the Ministry of National Education had two Funds, the Caisse des Recherches Scientifiques and the Caisse Nationale des Sciences the former responsible for financial assistance for the purchase of scientific equipment and the latter providing grants in aid to the scientific workers themselves In order to complete the system it was found necessary to set up a controlling body to consider general matters concerning research to co ordinate research work and to supervise the use of funds This was the purpose of the Decree of 21 June 1933 setting up a Conseil Supérieur de la Recherche Scientifique (Superior Council of Scientific Research) whose work was divided into eight branches, viz mathematics mechanics chemistry biology, natural sciences historical and philological sciences philosophy and social sciences

Caisse Nationale de la Recherche Scientifique The establishment of the Conseil Supérieur and the convenience of administration called for the merging of the two funds into one single national fund for scientific research This was achieved in 1935 by instituting the *Caisse Nationale de la Recherche Scientifique* (National Scientific Research Fund) The Caisse Nationale inherited the functions of the two institutions as well as those of certain services which were previously attached to the department of Higher Education It was managed by a Board of Administration with the assistance of Committees and Commissions of the former, the most important—those dealing with staff engaged in research—were formed from the branches of the Conseil Supérieur Fellowships and grants for scientific work were generally awarded for one academic year, running from 1 October to 30 September and were payable quarterly or, in exceptional cases, semi-annually The grades of workers were practically the same as under the Caisse Nationale des Sciences but new Experimental Fellowships were also instituted

Service Central de la Recherche Scientifique The establishment of a *Service Central de la Recherche Scientifique* by the Appropriations Bill of 31 December 1936, did not in any way alter the organization of the Caisse Nationale Its chief object seems to have been to associate the central administration of scientific research with the Ministry of National Education and to provide it with officials The Service also assumed direct control of a number of newly established research laboratories It was further responsible for organizing scientific missions to foreign countries

The Bill introduced, however, an innovation which was to develop greatly in the future setting up a body of technical assistants to co operate with the various kinds of research workers The organization of pure research as it existed in 1937 (in fact before World War II) may be represented as follows

Ministre de l'Education Nationale
(Minister of National Education)

Conseil Supérieur de la Recherche Scientifique (1930)
(Superior Council of Scientific Research)

Service Central de la Recherche Scientifique (1936)
(Central Service for Scientific Research)

Caisse Nationale de la Recherche Scientifique (1935)
(National Scientific Research Fund fusion of the two previously created funds Caisse des Recherches Scientifiques (1901)
and Caisse Nationale des Sciences (1930)

Recruiting & supporting of research workers Research Fellows Research workers Supervisors of Research Directors of Research	Subsidies to scientific publications	Grants in aid for purchase of scientific equipment	Grants in aid to scientists and their families in straitoned circumstances	Organization of foreign scientific missions	Financing and maintenance of a number of research laboratories

B APPLIED RESEARCH

Perrin s original plan, which was the basis of the government s legislative action in creating the public bodies during 1930 37, was principally aimed at promoting pure research It did not envisage the much needed integration and co ordination between the pure research and the applied research This is not to suggest that he in any way underrated the importance of applied research On the contrary, he was often heard to speak in favour of more intensive development of applied research "If pure research is the first source of civilization,' he observed, one cannot forget that the inventions and techniques which follow pure research are equally necessary and, moreover, facilitate in their turn new discoveries in pure science [*] He was more or less content to leave the task of organizing applied research to other government bodies which had been in existence since World War I

Office National des Recherches Scientifiques et des Inventions The emergency of the war and initiative of M Paul Painlevé (who, later on became Minister of War) were responsible for the establishment towards the end of 1915 of the *Service des Inventions* directly concerned with national defence In 1919 the Service was changed into the *Direction des Recherches Industrielles et des Inventions* and in 1922 again into the *Office National des Recherches Scientifiques et des Inventions* The Office was a public institution with financial autonomy and legal status It was managed by a Board of Administration under the supervision of a National Council of which the Minister of Education was Chairman and was run by a Director and Assistant Director The services covered by the Direction des Recherches Industrielles et des Inventions and the Commission Supérieure des Inventions which had been set up in 1887 were attached to it The functions of the Office were laid down in a decree of 16 January 1923 as follows To co ordinate and promote all types of research and in particular to develop and co ordinate applied scientific research to carry out work at the request of the public services to assist inventors

Centre National de la Recherche Scientifique Appliquee A decree of 25 May 1938 set up the *Centre National de la Recherche Scientifique Appliquee* (CNRSA) The CNSRA took over the functions rights and property of the Office des Inventions and at the same time covered a wider field of applied research It was also responsible for arranging for the mobilization of scientists and was under the direct control of the appropriate Minister or Under Secretary of State assisted by a *Haut Comite de Co ordination des Recherches Scientifiques* A *Conseil Superiur de la Recherche Scientifique Appliquee* was also set up under the chairmanship of the Minister or his representative and consisting of five branches applied mechanics applied chemistry applied biology applied physics In other words the CNRSA had the same administrative set up as the Caisse Nationale de la Recherche Scientifique A liaison between the CNRSA and the Caisse Nationale was however established but it never worked in practice

Lastly by the decree of 19 August 1938 there was set up within the Centre National de la Recherche Scientifique Appliquée a group of laboratories called the *Groupe des Laboratoires de Bellevue* For the time being this consisted of the services and equipment of the former Office National des Recherches Scientifiques et Industrielles et des Inventions

III NATIONAL CENTRE OF SCIENTIFIC RESEARCH (CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE)

From the foregoing account it would thus appear abundantly clear that until 1938 the government organization of pure and applied research took place along parallel lines and that one was more or less divorced from the other This constituted as was admitted on all sides a very serious weakness in the whole organization which was in no small way responsible for the comparative backwardness of French science and technology in the present century The demonstrated success in terms of better and more voluminous research output of the German British and American organization based on a closer integration of pure and applied research could no longer be ignored and gradually produced a strong desire among scientific circles and government department for a major reform long overdue

The creation of an Under Secretariat of State for Scientific Research the Sous secrétariat d Etat à la Recherche Scientifique with Madame Irène Joliot Curie as the head was primarily designed to establish co ordination between the Caisse Nationale and the CNRSA or more correctly to prevent these two bodies of different origin and constitution from developing each in its own way The Sous secrétariat however did not achieve much success in this work of co ordination and had to be closed down after a brief period of colourless existence Its failure emphasized the supreme necessity of fusing the two organizations into one organic institution simultaneously looking after the interests of both pure and applied research according to one common plan

In October 1939 as Hitler s armies were marching against the rest of Europe the Government announced the fusion of the Caisse Nationale and the CNRSA into one single organization the *Centre National de la Recherche Scientifique* (CNRS) The Centre took over the functions of both the previous institutions and was divided into two main divisions one dealing with pure research and the other with applied research The *Haut Comite de Coordination* and the *Conseil Superieur de la Recherche Scientifique* were changed into the *Haut Comité des Recherches Scientifique* and the *Conseil Consultatif de la Recherche Pure* Similarly many other consequential changes were effected

The activities of the Centre were almost brought to a standstill by the German occupation Some work in connection with the resistance movement is however reported to have continued underground which encouraged scientists to carry out certain aspects of defence research One notable example is that of Dr René Barthélémy who carried out important investigations in television and in the transmission of thousand line image

After the liberation a team of scientists under the leadership of Professor Joliot Curie (who was later succeeded by M Georges Teissier as Director of the

---

[*] Si la recherche pure est la source première de la civilisation, on ne peut oublier que l invention et la technique qui lui succedent sont également nécessaires et au surplus facilitent à leur tour de nouvelles decouvertes en science pure (*L Organisation de la Recherche Scientifique en France* 1938)

CNRS, after his appointment as High Commissioner of the newly established Atomic Energy Commission) took over the control of the Centre and planned a complete reorganization towards higher and more useful objectives The Decree of 2 November 1945, (*Journal Officiel* of 3 November 1945) provided for a new administrative set up and created an Administrative Council, a National Committee on Scientific Research, and a Directorate, which characterize the present organization of the CNRS

Administrative Council The Centre is administered by the Administrative Council (Conseil d'Administration) and by a Director and an Assistant Director The members of this Council are as follows

M Rouchon Mazerat, Council of State, *President*

M Cuvilher, *Vice President*

The Director of Higher Education

The Director of Technical Education

The Director of Budget to the Ministry of Finance, or his representative

M Mario Roques, member of the Academy of Inscriptions and Fine Arts and professor at the Collège de France

M F Joliot Curie High Commissioner of the Atomic Energy Commission

M Francis Perrin, Professor at the Faculty of Science Sorbonne

M Raoul de Vitry, Engineer of Mines

National Committee on Scientific Research The scientific programme and policy of the Centre is determined by the National Committee on Scientific Research (Comité National de la Recherche Scientifique) The Committee, divided into several sections, consists of permanent advisers and members chosen from among the scientists, research workers and technical men actively engaged in research The members and advisers are nominated by the Minister of National Education, on the recommendation of the Director

Directorate The Directorate, consisting of 15 principal members and 11 alternate members, carries out the decisions of the National Committee The Director and the Assistant Director of the Centre act as the President and Vice President of this body The Directorate represents the following branches of science and humanities *Mathematics* 2 principal members and 1 alternate *Astrophysics* 1 principal member and 1 alternate, *Mineralogy, Geology and Paleontology* 1 principal member and 1 alternate, *Physics* 2 principal members and 1 alternate, *Chemistry* 2 principal members and 1 alternate, *Biology* 2 principal members and 1 alternate, *Human Sciences* 2 principal members and 2 alternates, *Social Sciences* 2 principal members and 2 alternates, *Philosophy* 1 principal member and 1 alternate

In the management of the CNRS, the Director actually acts as the right hand of the Administrative Council

To consider special problems of scientific investigations proposed either by the National Committee or one of its sections, or by private organizations, the CNRS appoints commissions composed of members from within, and outside, the National Committee

Objectives The functions of the Centre thus reorganized were stated as follows in Article 2 of the Decree of 1945

> "It shall be the duty of the National Centre of Scientific Research to develop, direct and co ordinate all types of scientific research
>
> In particular, the Centre shall
>
> (1) carry out or cause to be carried out either on its own initiative or at the request of the public services or of private undertakings such investigations and research as are of acknowledged value for the development of science or of the national economy
>
> (2) encourage and facilitate research undertaken by the public service industry and private individuals make grants for this purpose to persons engaged whole time or part time in research recruit and pay assistants for research workers,
>
> (3) subsidize or set up certain laboratories for pure and applied research or develop those already existing, especially by assisting them to purchase instruments and equipment and in general such movable and real property as may be desirable for the advancement of science
>
> (4) co ordinate the research activities carried out by the public services, industry and private individuals by establishing liaison between the persons and bodies engaged in such research,
>
> (5) organize enquiries in public and private laboratories regarding the research undertaken and the resources available,
>
> (6) arrange either directly or by means of contributions or grants in aid, for the publication of accounts of interesting scientific work,
>
> (7) make grants in aid for scientific expeditions and for visits by research workers to French or foreign laboratories or research centres and,
>
> (8) organize and supervise preparatory training for research in the conditions specified by administrative regulations'

(*To be concluded*)

MARINE ALGAE AND FOOD PROBLEM

KALIPADA BISWAS
ROYAL BOTANIC GARDENS, CALCUTTA

ALGOLOGY is the study of a group of plants known as "Algae" which cannot properly be defined and separated from the other branches of plant kingdom such as Bryophyta, Pteridophyta and Spermatophyta It is an integral part of the evolution of the great Plant Kingdom and its phylogenetic development can be traced from some pigmented ancestors either from their flagellated members or from some separate ancestry possessing swarmers " (Fritsch, 1935)

The algae are distributed over vast areas on land, fresh waters, seas and oceans all over the globe They cover a vast range of organisms from the simplest protoplast which can hardly be differentiated from the bacteria to the highly evolved sea weeds of huge dimensions and elaborate morphological structures comparable to those of large trees with their greatly advanced and complicated life history

The distribution of the members of this branch of the plant world can also commonly be compared with the distribution of higher plants, exposed as they are to the different range of photic (light) and other ecological factors

The study of Algae or the science of Algology forms an important part of Limnology or the study of fresh water organisms both plants and animals, and plays a dominant part in the biological investigation of fresh, brackish and marine waters, pisciculture, supply of drinking water, sanitation, irrigation and communication in inland waters

The beauty of minute microscopic Diatoms are unsurpassed and the delicate artistic forms and different colours exhibited by various marine algae are objects of great admiration Truly, 'the vegetation of the sea may claim , as Shirley Hibbard writes, "a share of our attention, not alone for its variety and beauty or the mystery that surrounds its life in the depths of the ever changing waters, or for the usefulness to man of a considerable part of it, or for its intimate association with animal organisms that perhaps are more wonderful than itself, but above all things because it affords us one great and in a certain sense complete expression of the will of God in things created '

"In early times man used raw foods, as most animals still do In certain tropical island, old natives eat live fish which they catch in net They are found to take bites from it as casually as if they were eating a banana Before fire was discovered, food must have been taken in its natural state The smaller sea animals were eaten alive The flesh of larger animals was consumed as soon as possible after the hunt was over Nutritious roots were dug up and cleaned and feasted upon wherever they were found Green leaves and sea weeds were chewed and swallowed while still crisp and fresh" (Tilden, 1935) as it was the case with the refugees parachutists and troops fighting in the depths of the rain forests of Burma and Malaya and famine stricken men and women in Bengal during the last great war

"With the dawn and advancement of civilisation the same flesh of animals and edible parts of plants roots, stems, leaves and fruits are eaten by man like his remote ancestors But the form in which this food reaches the stomach undergoes manifold changes It is ground, sifted shredded, mixed, dried, tinned boiled, bottled, stewed, fried, steamed, fermented, pasteurised, sterilised and so on it is also covered with sauce dressings and condiments and it is even colored and beautified in a variety of ways The main point of difference however is this *the protoplasm has been killed, the vitamins have been destroyed for the most part by the application of heat* The physicians and biologists have now a days begun to realise the great problem before them of not only to discover means of obtaining more food by improvement of agriculture, fisheries and dairies but to find out the most nutritious matter contained in the food that we take The "deficiency disease' which is so alarmingly prevalent all over the world particularly after this war are mainly due to lack of something in the food used by the afflicted persons and animals '

The algal flora in fresh waters and seas occur in three zones First, there is the bottom zone composed of 'detritus' where the algae play a vital part in converting the decomposed organic matter into proper form of plant food, secondly the zone of submerged floating or attached plants and thirdly, the surface zone consisting of masses of various vegetable and animal organisms floating on the surface of water The middle zone of submerged and attached plants harbour many algae floating freely either horizontally or vertically on which feed many fish and other animals The masses of surface floating plants both large and small are known as *macro* or *micro plankton* composed either of plant—(*Phyto plankton*) or animal—(*Zoo plankton*) or a mixture of both—(*Phyto zoo plankton*)

"Algae absorb nourishment from the sea water which bathes their surfaces But the water must contain all the necessary foodstuffs—nitrogen compounds, carbonic acid, phosphoric acid, silica, calcium, and oxygen—for if any lacking the plants cease to grow The proper study of the marine alga, then must include the study of its food or, in other words, the chemical composition of the sea water The necessary food constituents are present in the waters near the shore, as a result of drainage from the land For this reason the sea shore constitutes the richest food producing region in the entire sea, whereas much of the ocean bottom—except in the vicinity of the shores, where it is covered with a layer of detritus—must be regarded as a desert waste" (Tilden, 1935)

"Sea animals, like those of the land, require organic food materials They depend entirely upon plants or other animals for their food, ingesting protein or amino acid from the living or dead organisms The scavengers find their food in the organic matter in the detritus on the sea bottom, the gill rakers live upon plankton forms but very many animals obtain their food, wholly or in part, directly from the attached sea weeds' (Tilden, 1936)

Then again if we compare the land flora with that of the fresh water flora we find there exists great similarity between them as regards their biology and ecology Like the marine algae there is the same succession of various types of aquatic plants growing under different environmental, physico-chemical, geological and biological factors There are both in lands and in waters fresh water and marine edible crops and also what we call weeds, that is those plants which grow in places where they are not wanted and whose uses are not yet known to us Recently some limnologists have estimated that the enormous quantities of food available in the vast masses of plankton of the seas and oceans are so rich in vitamin contents that these organisms can feed the entire population of the world Such a productive field of marine flora and fauna remains yet untapped The world is foolish in depending so much on wheat and rice

It will thus be realized that apart from the value of purely scientific investigation there is great practical value in the investigation of the vast field of marine vegetable resources along the coastline and in the seas of both in our country as well as elsewhere in the world

There exists undoubtedly great opportunity for trained freshwater and marine biologists particularly workers on Algae The life history of all species of algae occurring in inland fresh water and marine and brackish water areas must be worked out Their structures must be studied and their tissues observed and illustrated so that when minute portions are found in the digestive tracts of animals they may easily be recognized and tabulated Likewise, the life histories of "the fresh water and marine fauna particularly fishes must be followed, the digestive organs in particular being given thorough study The biochemists must discover the effects of the digestive juices of the animal upon the plant tissues digested and the effect of the plant upon the animal that consumes it'

"The Chinese have a proverb which represents popular opinion today with regard to life in the sea

"Big fish eat little fish,
Little fish eat shrimp;
Shrimp eat mud"

"There is no questioning the truth of the first statement and the second is approximately correct, but the third involves an entirely new problem and one of vast possibilities The great need at present is an extended, co operative scientific investigation of the "mud" in other words, the seaweed food—consumed by the Shrimp" (Tilden, 1935) There is thus a cycle between plant and animal life including man

The ultimate source of food for marine animals such as the cod fish whose liver oil is extremely rich in iodine and vitamins A and D which are of great therapeutic value lives on minute crustacea which in their turn feed upon marine algae rich in oil The algae along the coast forming vast expanse of "sea forest' are therefore the favourite haunts of marine fauna

All fat marine fishes contain the necessary food factors, so that not only is cod liver oil a wonderfully curative remedy for deficiency diseases, but all animal sea food—especially fish, oysters shrimps, lobsters, and crabs—contain valuable protein and fat and at the *same time is richer in vitamins* than the flesh of land animals and fresh water fish and far better source of iodine It may be stated with absolute truth that marine food is the best food known at the present time If cooked properly it is found that the food factors are not destroyed—except in the case of vitamin C, which may be obtained from fresh citrus and other fruits and from green vegetables

'No other known food substance contains such a high amount of iodine as some of the marine algae, the large coarse brown kelps in particular are very rich *in this element Tressler and Wells* report that dried Atlantic seaweed was found to contain 900,000 parts of iodine per billion of water

Marine algae form the ultimate source of food of marine fishes In the ocean the fringe of attached *algae clothing the rocks and reefs along the shores* furnishes a perennial supply of food for marine animals Hordes of invertebrates pass through all the stages of their existence in the meshes formed by the interlacing branches of this miniature submarine forest. In tropical waters millions of schools of brightly colored reef fish, golden yellow, green, orange, blue, crimson and purple, may be seen hovering over these seaweeds, darting swiftly from one plant to another, nipping off a branch here, a succulent fruit there —an activity due however, not to the necessity of having to procure prey but to the fact that they themselves form the prey of innumerable enemies In spite of their agility they do not always elude capture, for they furnish sustenance to hordes of larger fish which come in from deeper water, alone or in schools, to feed upon them"

"Although it is not generally recognised as a fact, it is the algae of the ocean consisting of both attached seaweeds and plankton forms, that constitute the basis link in the food chain of all our important food fish These in turn are consumed by man, who forms the terminal link in the chain" (Tilden)

The study of the food of fish must receive more and more attention The importance of tracing food successions from the marine plants to the fish used as food by man must be realized A knowledge of the structures and life processes of the algae is fundamental to any scientific investigation of their use indirectly —as food for fishes—or directly to man (Biswas, 1937)

REFERENCES

Biswas, K. Association of some of the Common Algae with animals in Indian waters, *Hedwigia, Leipzig, Band 76* 1937
Cornwall, Berry The Sea weed collector
Fritsch, F E Structure & reproduction of the Algae, Vol. I, and II, 1935 & 1945
Hibbard, S The Sea weed collector
Tilden, J E The Algae & their life relations, 1935

SOME ASPECTS OF STUDY IN THE LIFE HISTORY OF INSECTS

G A PATEL[1], R R SAVOOR[2] AND A C BASU[3]

WHILE studying such characters like the duration of the egg, larval and pupal stages or the fecundity, longevity, pre oviposition and pre mating periods of adults of a particular species of insect, it is commonly experienced that the period is not well defined and results are usually given as, 'the duration of egg stage varies from 1 to 6 days' as is the case in *Plutella maculipennis* (Curtis) or that the larval stage lasts from 12 to 18 days" as is the case in *Epilachna 28 punctata* F, and so on This in fact is a gross under statement and at times amounts to an erroneous interpretation, since it does not define in a rational and precise manner the extent, magnitude and the manner of variation within the stated range The inexactness in stating only the variation of a magnitude of a character under study, has not been overlooked by modern taxonomists, and it has become customary and essential to give in a determinate manner the details of the variation observed in a morphological character For this purpose, it has been found necessary to study a larger number of individuals for the same character and group them according to the magnitude of the character The resulting distribution enables an exact estimation of the different statistics such as mean mode or standard deviation which help us to clearly define the variation observed (Huxley, 1940)

For the reason that a species is inherently variable as to its susceptibility to an insecticide, a method on similar lines for a more accurate statement is also adapted by the insect toxicologist, and in the laboratory testing of the resistance of a species to an insecticide it has become incumbent to study a large number of individuals, and group them according to the magnitude of their resistance (Wadley, 1943). However, in the study of such characters like the duration of the stages of insects, and other characters like the fecundity and longevity of adults in the life history of an insect, this method has not come in vogue To illustrate, the following table gives the period in the pupal stage of 605 individuals of *Plutella maculipennis* (Curtis) at 750° ± 5° F

TABLE 1

DURATION OF THE PUPAL PERIOD OF *Plutella maculipennis* AT 75°±5°F

Number of days in pupal stage	3	4	5	6	7	8	Total
Number of individuals observed	11	113	377	95	8	1	605

It can be clearly seen that a casual statement that the pupal period of this species lasts 3 8 days is grossly inadequate, because over 96 per cent of the pupa emerge within 4-6 days, with the additional fact that over 60 per cent of them emerge on the 5th day alone The results obtained may be safely accepted as typical for the species, owing to the fact that a sufficiently large number of individuals have been investigated

TABLE 2

DURATION OF LARVAL STAGE OF *Plutella maculipennis* at 75°±5°F

Number of days in larval stage	7	8	9	10	11	12	13	14	15	Total
Number of individuals observed	27	148	219	257	97	38	9	2	1	798

A similar study of the duration of the larval stage of the same species, yields the data given in Table 2, where, the variation of this character extends from 7 to 15 days. In this case although the individuals are distributed more smoothly and equitably over many of the classes, than is the case with the pupal stage, it is clear that over 78 per cent of the individuals take only 8 to 10 days, and this fact has to be taken into account

---

[1] G A. Patel, Professor of Entomology, [2] R. R. Savoor, Professor of Statistics, at the Institute of Agriculture, Anand, and [3] A. C. Basu, Entomological Assistant, Government of West Bengal, Chinsura.

An even more striking case of the manner of variation is exhibited by data on the duration of the egg stage of this species

TABLE 3

DURATION OF EGG STAGE OF *Plutella maculipennis at* 75° ± 5°F

Number of days in egg stage	1	1	3	24	5	6	Total
Number of eggs observed	20	281	2218	269	31	1	2820

Out of 2820 individuals observed a total of 2218, amounting to nearly 80 per cent of the eggs hatch on the 3rd day alone A curve drawn to represent the data of Table 3 would result in a steep peak on the 3rd day declining sharply on either side, indicating a strong tendency for a lepto kurtic curve, wherein nearly 80 per cent of the area lies in the immediate neighbourhood of the peak

Thus, to obtain a comprehensive idea regarding the duration of life stages of insects, the range of variability should be studied along with the spread of individuals over the various classes The necessity is no less acute in those cases where the spread is uniform over the classes, or in particular those observations, a curve drawn to represent which will be of the uni modal type A systematic study will involve the distribution of the individuals into various classes in which the magnitude of the character is divided When drawing valid conclusions pertaining to the variability of these characters, it is necessary that the observations under consideration should be adequately large to facilitate justifiably acceptable inferences

REFERENCES

Huxley Julian —The New Systematics Oxford University Press 1940

Wadley F M —Statistical aspects of laboratory tests of insecticides Am Assoc Adv Scien Pub No 20 177 188, 1943

THEORIES AND OPERATION CHARACTERISTICS OF LEAD-ACID BATTERIES

V I N ROW

ESSENTIALLY the storage battery consists of two dissimilar electrodes held apart from each other in a conducting liquid known as the electrolyte These electrodes with their surrounding electrolyte must differ from each other so as to produce different potentials with respect to the electrolyte and also in the available or free energy The difference in potential between the two electrodes constitutes the electromotive force of the cell

When connected together through an external resistance a current flows proportional to the difference of potentials, and inversely proportional to the sum of the battery and external resistances The current is actually transported from one electrode to the other through the external circuit by charged particles called ions At the surface of the electrodes where the electronic conduction changes to ionic conduction chemical reactions occur The material of the positive electrode is usually chemical compound like PbO_2, MnO_2, NiO_2, CuO, or AgCl These are all depolarizing materials which have a great propensity in easily accepting electrons, but in so doing they get reduced to a lower state of oxidation The materials of the negative electrodes are such as Pb, Fe, Cd or Zn They are characteristically known for their propensity to part with electrons, which form the positively charged ions in the electrolyte This being the reverse of the reduction process forms the oxidation process

These two processes are normally accompanied by chemical changes which are also accompanied by changes in the electrolyte, all scrupulously according to the Laws of Faraday But externally we say that the battery is discharging when it is supplying the current and that it is charging when it is taking electric current, the charge and discharge simply being the results of conversion of electrical energy to chemical energy and *vice versa*, exactly according to the laws of thermodynamics

The electrolyte which provides the ionic conduction between the electrodes should be selected from the nature and characteristics of the electrodes selected, its exact purpose differing in different types of batteries For instance, in the Edison's Nickel Iron battery it serves as a simple electrolytic conductor, while in the lead acid battery it does take part in the chemical reactions, taking place in both the electrodes

The accepted convention for the direction of flow of current is from positive to negative, exactly opposite to that of the flow of electrons The rate at which the chemical reaction occurs depends on the rate of electronic exchanges at the electrodes, which in turn depends upon diffusion, temperature, effective surface, and prevailing conditions of the electrode surface

The Double Sulphate Theory of Lead Acid Batteries

The chemical reactions taking place in a lead acid battery for charge and discharge have for a very long time been subject to dispute and argument The oldest theory put forward in 1882, was that of Gladstone and Tribe and popularly known as the Double Sulphate Theory, on the basis of their observations that lead sulphate is formed at both positive and negative electrodes during discharge and that it could be oxidized at one plate and reduced at the other during charge Expressed by means of an equation

$$PbO_2 + 2H_2SO_4 + Pb \underset{\leftarrow}{\overset{\rightarrow}{}} 2PbSO_4 + 2H_2O \qquad (1)$$

When the cell discharges the reaction proceeds to the right, but this is reversed during charge The equation shows the passage of 1 Faraday of electricity (96, 500 Coulombs) in the direction of discharge and results in the consumption of one equivalent of PbO_2 and Pb and two equivalents of H_2SO_4, while two equivalents of lead sulphate and water are formed The results obtained for the quantity of electricity passing and the materials consumed or formed have not found common agreement Perhaps the correct solution could only be obtained if we could accurately and precisely determine the degree of concentration of the electrolyte at any stage of discharge or charge Personally, I feel that although this may seem apparently to be an easy matter it is not so judging by the widely different results achieved

Craig was probably the first to determine to a reasonable amount of accuracy the acid consumption during discharge and also the formation of water The results achieved by him confirm the Gladstone Tribe double sulphate theory without any assumptions

Having established the theory from practical results, we can apply thermodynamic reasoning and compare the heat of the reaction based on thermochemical data The first involves no electrical phenomenon while the second deals with electrical measurements only Or rather we are dealing with the conversion of energy from chemical to electrical or *vice versa* as represented by the heat of reaction produced

The heat of reaction in a storage battery involves that of all the constituents, including plates and the solutions For solids definite values of the heat formation are available which usually do not vary with the change of concentration of the electrolyte The only variable factor is the degree of concentration of the electrolyte, involving the partial molal heat content of acid and water From infinite dilution where the partial molal heats are zero, to the other extreme of undiluted sulphuric acid of 23 45 kilo-calories per mole, we can now get the heats for any concentration.

Turning to the electrical side, the thermodynamical relation between electrical measurements and heat of extraction is expressed by the Gibbs-Helmholtz equation which may be written as follows —

$$\Delta H = -\frac{2 \times 96{,}500}{4\ 1833}\left(E - T\frac{dE}{dT}\right) \qquad (2)$$

Where ΔH is the heat of reaction in calories

E the electromotive force,

T the absolute temperature,

and $\frac{dE}{dT}$ the temperature coefficient

All these quantities could be measured precisely excepting ΔH The equation could be represented on simplification as

$$\Delta H = -46136\left\{E - (\text{degrees in Cent} + 273\ 16)\frac{dE}{dT}\right\} \qquad (3)$$

The following table gives the electromotive force and temperature coefficient as a function of acid concentration and in parallel columns the heat of reaction, on the basis of electro chemical and thermo chemical computations Considering the many sources of error, the agreement in the results is rather remarkable, showing the double sulphate theory to be the stablest of all those that have been advanced

TABLE

Specific Gravity $\frac{25\ C}{25\ C}$ Centigrade	Sulphuric Acid Percent	Experimental Determination		Heat of Reaction	
		Emf at 25 C (Volts)	$\Delta E/\Delta T$ (Mv/C)	Electro Chemical Kilocalories	Thermo Chemical Kilocalories
1 020	3 05	1 855	(−0 05)	(−86 28)	−86 32
1 050	7 44	1 905	+0 15	−85 83	86 53
1 100	14 72	1 962	0 29	−86 54	−87 44
1 150	21 38	2 005	0 33	87 97	−88 87
1 200	27 66	2 050	0 30	−90 46	−90 9
1 250	33 80	- 098	0 22	−93 77	−93 65
1 300	39 70	148	0 18	−93 63	−93 51

Operating Characteristics of Lead—Acid Batteries

The discharge output of storage batteries normally exceeds the specified manufacturers' rating until it nears its serviceable period (which may be specified as 80% of rated capacity) Ratings are usually based on discharge for some specified period like 5 hrs or 20 hrs and so on A battery which can deliver 5 Amps for 20 hrs is said to have a capacity of 100 Ampere—hours but may not be able to deliver 20 amperes for 5 hours The capacity decreases as the rate of discharge increases The relation of current and time may be expressed by the equation

$I^n t =$ a constant (the capacity),

in which I is the current, n is a constant for the type of the battery ranging from 1 3 to 1 5 Estimates of the capacity at various rates are conveniently made from linear graphs or by means of the slide rule Temperature too has an important effect on the discharge characteristic of a lead storage battery because the resistivity and viscosity of the electrolyte vary with temperature An increase of resistivity produces a greater IR drop inside the battery while an increase in viscosity (with decrease in temperature) decreases the rate of diffusion of electrolyte into the pores of the plates which also reduces the working voltage of the cell.

The working voltage falls gradually as discharge proceeds until the concentration in the pores of the plates has diminished to a point beyond which the rate of discharge no longer can be maintained This occurs at about 1.7 volts for normal rates Further discharge could only be made after a period of rest during which period some diffusion occurs Some gassing also may be noticed either during discharge or during the rest period as a result of local action Ventilation is of course absolutely essential The charge of the lead acid battery is accomplished by applying an electromotive force in excess and opposite in polarity to that of the battery If the difference is very small the battery is said to 'float' on the charging line If the difference between the applied e m f and the batteries counter electromotive force is great, this results in a larger charging current If the charging current is held constant, the counter electromotive force rises gradually until the number of ampere hours supplied substantially equals the number of ampere hours previously discharged At this point more rapid increase in voltage and temperature is noticed The charging current is normally reduced to a specified finishing rate at this point

This property of a battery to absorb electric energy at very high rates when in a discharged state should be correctly understood to get the maximum efficiency To avoid excessive temperatures and gassing, the rate of charge at any time should not exceed the limits set by the ampere hour law' That is, the charging rate in amperes at any time t, should not exceed the numerical value of the ampere hours at that time lacking for a full charge With the proper choice of the applied constant potential, charging becomes for the most part automatic because the counter electromotive force of the battery rises as the charge proceeds and this automatically decreases the charging rate If the charging law is to be followed very closely 50% of the total charge may be supplied in about 40 minutes, 75% in about 1 hour and 20 minutes, and 90% in about 2 hours and 20 minutes The applied potential for constant potential charging is from 2.15 to 2.35 volts per cell depending on the service required of the cell

When a battery is connected directly to the bus, charge or discharge occurs according to the conditions at the moment Temperature always plays an important role At very low temperatures a higher bus voltage is needed to charge the batteries at satisfactory rates, and too high voltages at high temperatures lead to the vicious circle i e the current first decreasing to a minimum, and then rising again, as the battery is warmed thus causing a condition of instability The condition for stability is that the voltage of the charging bus must be higher than that for constant potential charging and this is obtained by including a small fixed resistance in the circuit The initial charging rate is lower the final rate is higher and the time somewhat longer than for the straight constant potential charge

REFERENCES

[1] Gladstone J H and Tribe A The Chemistry of Secondary Storage Batteries (Macmillans)

[2] Craig D N and Vinal G W *Journal of Research* *14* 449 1935 *24* 475 1940 National Bureau of Standards Washington D C

[3] McMurdie H F Craig D N and Vinal G W *Transactions of Electro Chemical Society* *N Y* *90* 509 1946

Woodbridge J L Storage Battery Charging *Transactions of Electro Chemical Society* *54* pp 516 2 1935

[4] Row V L N Maintenance of Batteries, Industry Publishers Ltd Calcutta

IMPRESSIONS OF INDIA*

ALBERT F BLAKESLEE†

Director Smith College Genetics Experiment Station U S A

THIS is a report of our trip during the winter of 1946-47 to the Indian Science Congress in Delhi to which Dr Wm Edwards Deming and I were delegates from the A A A S With the exception of Dr Shapley who arrived after the Congress had started, the American and Canadian delegates left La Guardia Field December 22 on a BOAC Constellation four engined plane for an eleven hour flight to Shannon Airport in Ireland ** There, while we had an early breakfast, we learned a lesson in nationalism from the labels over the various doors—they were in Erse as well as in English and French Questioned, all the attendants confessed, however, that they could not speak the Irish language, although it is now a compulsory subject in Irish schools

In London we waited a week for a chartered plane This took us and the British delegates to Karachi with stopovers at Malta, Cairo and Basra An Indian government plane then took us from Karachi to Delhi Delayed by fog at the London airport, we were a day late in arriving in consequence, the Congress opened its sessions one day late

After the Congress, for the most part in the company of Dr W F Hanna, of the Rust Research Laboratory of Winnipeg I visited the Forest Institute at Dehra Dun, universities and scientific institutions at Lahore, Lucknow, Benares, Calcutta, Darjeeling, Hyderabad, Madras, Bombay, Jodhpur and Karachi Each of us gave one or more lectures in most of the cities I left India by plane of Feburary 9 and, after short stops in Paris and London arrived in New York on February 18 on the Queen Elizabeth Some of the delegates had shorter, and some longer, stays in India

I shall not attempt to give a detailed report, but shall instead report some impressions of India gleaned from an all too hurried visit to that interesting country

India is faraway from us in customs and taboos, near though it is in time (thirty four actual flight hours) It is land of great contrasts—in climate, races, languages, religions, and types of government To us the greatest contrast was the extreme poverty of the masses and the comfortable, even luxurious standards of living of the upper classes As an example, we found people sleeping in the streets and on the steps of the great Mosque of Delhi because they had no other place to go, later, we were lavishly entertained in the Viceroy's sumptuous palace in New Delhi and were given a banquet by a wealthy industrialist, where we were served various wines and champagnes Delegates to the Congress came in contact primarily with the university people and with the governing classes both Indian and English

In the Science Congress we found the meetings of various scientific sessions much like those of our own American Association for the Advancement of Science

The discussions were keen, and the criticisms of the papers were searching We were all impressed, I believe, with the knowledge the Indians had of foreign literature, and I had an experience similar to others in finding that my own work was well known to the specialists in my particular field

It was a surprise to many Americans to learn that the Indian Congress was conducted entirely in English, although there are several hundred more or less distinct languages or dialects spoken in India Those in the north trace their origin to the Sanskrit The Dravidian languages in the south have an entirely different origin English, in consequence, serves as a lingua franca and is spoken fluently by all educated Indians With the exception of the two Moslem universities, it is the language of instruction in all Indian institutions of higher education The value, at least to science, of a single universal language in which all educated men can converse is obvious It was with some concern, therefore, that we found among some of the university people in India a desire to develop a single national Indian language to take the place of English, although even Hindustani would have to be learned as a foreign language by a large proportion of the people Perhaps this feeling was both an expression of nationalism and a reaction against anything connected with the English Possibly our desire to see the spread of English as a world language fostered rather than restricted is somewhat influenced by our own nationalistic instincts, but I believe I should feel the same way about French or German if either were as widely used

---

*Reprinted from, and with kind acknowledgement to *The Scientific Monthly* Vol LXVI, No 2, February, 1948 (Ed *Sci & Cul*)

†Dr Balkeslee has had a long and distinguished scientific career In 1904 he went to Europe as an investigator for the Carnegie Institution. In 1915 he became its resident investigator for plant genetics and finally in 1936 became Director of the department which post he held until 1941 when he joined his present post Dr Blakeslee was president of A. A A S in 1940 and is widely known for his classical researches on the genetics, cytogenetics and origin of the *Daturas* of the old and the new world

**The Canadian delegates were W F Hanna, T L Tanton and R B Thomson Those from the United States were A F Blakeslee, W E Deming, E N Harvey, Oscar Riddle, and Harlow Shapley Those from England were P M S Blackett, William Brown, Sir Charles Darwin, Sir Arthur Fleming, Munro Fox, L J Mordell Sir Harold Spencer-Jones, Dudley Stamp, and Sir D Arcy Thompson V P Volgin and E N Pavlovsky represented the Soviet Union, Jacques Hadamard represented France. and S S. Chern, China. (For fuller details regarding these delegates, see *Science and Culture, 12*, February, 1947) and appeared to have a better chance of general adoption

India attributes to us many wonderful things for which we should not have credit For example, an able woman botanist, in discussing the economic value of algae, said that in India they ought to do as we did in the United States, where every farmer had a fish pond in which he put certain chemicals to induce the growth of algae Fish fed upon the algae and the farmer could go out and bring in a crop whenever he desired! Some of the American delegates had heard of this scheme, but none of us had ever actually seen such a fish pond

Indians believe that we do everything by mechanical contrivances, and, when told that in our homes we had to get along very largely without servants—of which there is an abundance in India—they would reply, ' Oh, yes, but you do everything in your houses by push buttons

Indian students also look to America We were besieged by students who wanted our assistance in securing admission to American universities They even called at our rooms before breakfast One boy who wanted to come to the United States to study atomic physics was only fifteen years old

The Indians with political influence look to America For instance, Nehru, who invited Dr Shapley and me to dinner one evening with two Indian scientists was very eager to learn the attitude of Americans regarding our foreign policy more particularly in its relation to Russia He asked especially about the effect of the Republican victories in 1946 on our policies We were greatly impressed by Nehru s keen interest in, and understanding of, movements in other countries and by his efforts toward the betterment of his own people Although Indians of all classes look to American and Western civilization, they do not wish to be placed in the position of an inferior people asking alms They resent the ' master race" discrimination exercised toward them both in India and in South Africa In retaliation they have established a boycott against African goods and in the Taj Mahal Hotel in Bombay there are signs reading 'No South African Allowed

The British also depend upon America In January and February, 1947, when we were in India, the British government had not yet set a date for leaving India, but all the British officials realized that the government would soon have to be turned over to Indians The British expect America to give at least moral support in helping India to get on its own feet

The Indians have a civilization of which they are justly proud for its origin may be traced back to Sanskrit times, some of the literature in the Vedas going back to about 2000 B C I became convinced that they are not mentally inferior, as we were led to believe before going to India and as was also the impression one would gain from discussions with the British governors of India. The Indians realize that they must depend on Western civilization for their science and technology I feel, however, that the differences in their scientific and technological outlook are due primarily to environment rather than to genetic constitution, hence, they are more amenable to change

In my talks with Indian educators I pointed out that up to the early part of the present century we had to look to Europe, especially to Germany, for leadership in science, and that it is not so long ago that America (and Europe) came to realize that this was no longer necessary In the same way, the Indians realize that they must get foreign training, and they have established fellowships for their best students to study abroad Whatever short-comings in colonial policy may be blamed upon the British, there was evidence that they had done much for the development and application of Indian science, at least in medicine Many Englishmen we met had devoted the better part of their lives to scientific service in important posts in India, and some of them were seeking positions in other countries in view of the early withdrawal of English control It is to be hoped that the value of their service will not be entirely lost, and that standards may even be raised now that India has taken over complete control of her own destiny

The British in India have said that as scientists the Indians are most successful in mathematics and theoretical physics This seemed to be true, although Raman, who received the Nobel Prize in physics, was and is a good experimentalist Indians, however, do not seem in general to do so well in experimental sciences There were, of course, some notable exceptions and in some of the laboratories we visited there was a keen spirit of research

The greatest fault I could find with Indian scientists was a certain disinclination to use their hands This fault I have also found among some other foreign scientists The lack of appreciation of the dignity of manual labour as well as the caste system—which now appears to be in process of gradual elimination —is a great handicap to their technological advancement For example, an Indian who, when I met him, was scientific and technological adviser to one of the Indian states, told me that when he was a student in one of the institutes of technology in the United States he did as many of the other students did, namely, earned money during the summer in manual labour, washing dishes in a hotel, etc When he wrote his parents what he was doing, he received two cablegrams telling him to stop it at once — that he was disgracing his family The same scientist told me that he had available an industrial position at 1,200 rupees (about $400) per month but that if he paid someone that salary he felt the man would not want to work in the shop, but would wish merely to sit at a desk Perhaps as valuable a thing as any that I told Indian scientists with whom I had conversation was that I helped my wife wipe the dishes in our own household

The willingness to do — even at times the necessity of doing— things with one's own hands would be one of the best lessons, I feel, that could be learned by Indians who visit our country

One of the American vice consuls in India told me that the difference between Indians and Americans could be demonstrated by the fact that, when an American gets a Ph D degree, that is the start of his going to work more intensively, but when an Indian gets a Ph D, that is likely to be the end of his work—he feels he has reached his goal

I did get the impression that there was in many cases a letdown in the scientific activity of Indians who had reached a full professorship in their universities I also found that the position of a man seemed to be more esteemed than the work he was actually doing In one or two cases, the men who appeared to me to be doing the most original work in certain institutions had considerable difficulty in getting to me to talk about their investigations In fact, I sometimes had the feeling they were actually being kept from me

That "pull" is considered of much value in advancement was suggested by several requests made to me that I mention the work of certain Indians when I gave my lecture at their institutions Another example is a letter recently received from a student who had failed to secure a fellowship from the Indian government to study for a doctor's degree in the Genetics Experiment Station at Smith He intimated that influence was important and suggested that I write to certain government officials urging them to reconsider their decision not to award him a fellowship We heard other complaints that on account of political and personal influence Indian fellowship did not always go to the best students Whether these complaints were sometimes justified or were merely the reactions of disappointed candidates, we were not able to judge Naturally, however, I did not write the letters requested

I should like to be a *Maharaja* not because of the great wealth and multiplicity of wives or their equivalents, with accompanying luxurious living, but rather for the good that I might do by means of science and its application We were impressed with the need of and opportunities for, intelligent philanthropy, both public and private We had the privilege of visiting a few institutions established and maintained in whole or in large part by private donations Among these were the Bose Institute for Plant Research in Calcutta the Tata Hospital in Bombay and the Sir Shri Ram Industrial Institute in Delhi, the dedication of which we attended during the Congress Such institutions however, appear to be relatively rare Wealthy industrialists are not so numerous in India as with us, and in general they seem not to have acquired the habit of philanthropy in support of science and education

Many prominent Indians have had British titles conferred upon them These are highly esteemed despite the feeling in some quarters that their bestowal has been an attempt to buy allegiance to the British crown If I were a member of the Indian government, I would suggest that India take over the conferring of titles, but on a revised basis adapted to her own country I would suggest the title of 'Indian Benefactor" for those who had made significant contributions to the welfare of India in art literature, science or philanthropy Such titles might correspond to Nobel Prizes, but on a broader basis A man so honored might write after his name the initials I B (B I Benefactor of India, might be confused with British India") He might be addressed in the new Indian system as Benefactor Izzd Singh or more simply, Bene Izzid, instead of the English system of Sir John Doe which is usually simplified to Sir John Such a system of nobility might emphasize the fact that service to one's own people is most worthy of recognition

The frank criticism I have made regarding some things that I feel are imperfections among the Indian scientists could be made also of many of our own American institutions I came back from my trip, however with a great enthusiasm for our Indian friends and a strong feeling that India is a land of great potential powers

The scientists and students we met appeared very appreciative of our visits and lectures I myself feel that I got more than I gave in adult education The trip was undoubtedly of value to both the scientists of India and those abroad in fostering international understanding This, I believe, can best be done through science, for there is only one science

THE COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH

The Council of Scientific and Industrial Research which met in New Delhi on July 11 and 12 adopted a number of resolutions the most important of which was the establishment of a National Research Development Corporation in India on the lines of similar corporations in Britain, the U S A and Canada for commercial exploitation of the results of research by Indian scientists

NATIONAL RESEARCH DEVELOPMENT CORPORATION

The primary object of this Corporation would be to give new processes developed in India a try out on a semi commercial scale, so that Indian industrialists may be encouraged to adopt them on a large scale It is stated that Rs 50 lakhs capital and Rs 5 lakhs recurring would be necessary to float the Corporation A committee, with Sri Ardeshir Dalal as *chairman*, Dr J C Ghosh, Sri Kasturbhai Lalbhai, Sri Shri Ram and Dr S S Bhatnagar as *members*, has been set up to work out details The Council has also approved the setting up of pilot plants in the National Research Laboratories so that the Council's researches may be made of immediate practical benefit to industry Demonstrations to show industrialists how newly developed processes could be operated on a full production basis will be arranged in those pilot plants In order to make Indian industry research conscious, the Council has adopted proposals for rendering greater technical assistance to Indian industry An Industrial Relations Officer will be appointed to maintain liaison with all the major trade associations and Chambers of Commerce, and technical experts of the Council will be deputed to visit factories to render such technical advice as may be necessary in the exploitation of new processes

BOARD OF ENGINEERING RESEARCH

Establishment of a Board of Engineering Research to stimulate and co ordinate research in various branches of engineering in India has been recommended The Board will look after civil engineering of all types, irrigation, mechanical, electrical, power and textile engineering, and will function under the auspices of the Council of Scientific and Industrial Research

PILOT PLANT EXPERIMENTS ON SYNTHETIC PETROL

Two projects relating to the possibility of producing synthetic petrol, one costing Rs 23 crores and the other Rs 40 crores prepared by American experts, are under consideration of the Govt of India Indian coals have been sent to the U S A for investigation in this connection The Council has now proposed that the pilot-plant investigations on the synthesis of petrol from coal should be done in India itself These pilot-plant investigations are necessary in order that various types of low grade coals are examined and manufacturing conditions determined before put into actual production

Another important proposal of the Council which would conserve the high class metallurgical coal resources of the country and enable the utilization of the high ash low grade coals is that coal in pulverised form should be used for firing boilers, both stationary and locomotive The Fuel Research Institute of the Council will shortly undertake research in this connection Meanwhile, the Council has suggested to the Government that a boiler of this type should be imported and set up as an experimental measure at one of the power stations in the Damodar Valley area

It has also proposed large scale research on pulverised coal burning gas turbine locomotives, if the Government decided to introduce such locomotives on India s railways A complete change over to these locomotives would reduce the coal consumption of India s railways by 50 per cent, resulting in an annual saving of over Rs 10 crores

Another recommendation is that the Government should institute a comprehensive inquiry into the question of electrification of India's railways in high traffic density areas, particularly in the vicinity of the coal fields

Following two important investigations carried out by the Council on the washability of Indian coals and the blending of coals for coking purposes, the Government of India recently set up a Coal Conservation Committee to advise on utilization of the results of those researches

The Fuel Research Institute is conducting a country wide research of coal resources, and for this purpose five Regional Coal Survey stations are in the course of erection in the chief coal mining areas of the country A Fuel Economy and Combustion Section is also being established at the Fuel Research Institute to advise consumers of coal on matters relating to fuel economy

SALT RESEARCH

The Indian Standards Institution has constituted a Committee to fix standards of purity for salt manufactured in India for various industries and the Council recommended that these standards be soon introduced in the salt industry It has now proposed that a Salt Research Station and Model Farm be established at Wadala, Bombay, where scientific methods of salt production would be worked out and demonstrated to salt producers

Another research station to deal with problems of salt manufacture from lake and pit brine is proposed to be established at Sambhar Lake

The Council has recommended to the Government that the Mandi Salt Mines and the salt deposits in the Rann of Cutch should also be developed

BOTANICAL RESEARCH ON INDIGENOUS DRUGS

The Council has proposed the setting up of a full division at the Central Drug Research Institute, Lucknow, for undertaking botanical research on indigenous drugs This division, besides carrying out laboratory investigations, will undertake experimental cultivation, surveys, grading and sorting of indigenous drugs and also serve as a centre of intelligence and technical assistance to the industry A nucleus unit of pharmacological research will continue to remain at Calcutta

HIGH ALTITUDE RESEARCH STATION

On the recommendation of the Council, a party of three scientists visited Sikkim and Jumontri on the Himalayas for selection of a suitable site for the establishment of a High Altitude Research Station The Committee will soon visit the Baralacha area, after which final selection of the site will be made

An expert sub committee, consisting of eminent scientists, is drawing up a detailed plan for the Research Station, which will be fully equipped to handle snow survey and glaciology, meteorology, astronomy and cosmic ray research and investigations on mineral resources and the flora and fauna of the Himalayan regions The research station will function under the joint auspices of the Council, the Central Waterpower, Irrigation and Navigation Commission and the Indian Meteorological Department (See SCIENCE AND CULTURE, July 1949, p 27)

TRAINING IN RADAR

The Radio Research Committee of the Council proposes to organize in October this year in Delhi, a Symposium on Radar and Ultra short and Micro waves, to which over 50 scientists from all parts of India are being invited An exhibition of radar and micro-wave equipment will also be held on the occasion of the symposium

The Council has also proposed to arrange short term training courses in Radar for research workers in universities as also to meet the defence needs of the country

SILK RESEARCH INSTITUTE

A contribution of Rs 15 lakhs from the Silk and Art Silk Manufacturers Association towards the establishment of a Silk and Art Silk Research Association was formally accepted by the Council A Research Institute will be established in Bombay under the auspices of this Association, and its function will include research in weaving and manufacture of rayon as well as silk and processing, dyeing, bleaching, printing and finishing of silk and art silk fabrics The Government of India will be requested to make a suitable contribution to supplement the donation of the silk manufacturers

The Council accepted a proposal from the Indian Statistical Institute, Bombay, for the establishment of a Research Unit in Quality Control to serve the needs of industries in Bombay This research centre will be attached to a training centre in Quality Control which will be financed by industry in Bombay

NEW SCHEMES OF RESEARCH

On the recommendations of the Board of Scientific and Industrial Research, the Governing Body of the Council has sanctioned eleven new schemes of research at a cost of Rs 1,50,000/

"*What is it that India is to win and maintain ? Has her own history and the teaching of the past prepared her for some temporary and quite subordinate gain ? There are at this moment two complementary and not antagonistic ideals before the country There is first, the individualistic ideal of winning success in all affairs, of securing material efficiency and of satisfaction of personal ambition These are necessary, but by themselves cannot ensure the life of a nation Such material activities have brought in the West their fruit, in accession of power and wealth There has been feverish rush even in the realm of science for exploiting applications of knowledge, not so often for saving as for causing destruction In the absence of some power of restraint, civilization is now trembling in an unstable poise on the brink of ruin Some complementary ideal there must be to save man from that mad rush which must end in disaster He has followed the lure and excitement of some insatiable ambition, never pausing for a moment to think of the ultimate object for which success was to serve as a temporary incentive He forgot that far more potent than competition, was mutual help and co-operation in the scheme of life And in this country through millenniums, there always have been some who, beyond the immediate and absorbing prize of the hour, sought for the realization of the highest ideal of life—not through passive renunciation, but through active struggle The weakling who has refused the conflict, having acquired nothing, has nothing to renounce He alone who has striven and won can enrich the world by giving away the fruits of his victorious experience In India such examples of constant realization of ideals through work have resulted in the formation of a continuous living tradition And by her latent power of rejuvenescence she has readjusted herself through infinite transformations Thus while the soul of Babylon and the Nile valley have transmigrated ours still remains vital and with capacity of absorbing what time has brought, and making it one with itself.*"—(Extract from Sir J C Bose s Inaugural address in dedication of the Bose Institute, November 30, 1917).

Notes and News

SYMPOSIUM ON FOOD AND PEOPLE

An analysis of the various factors responsible for the present world food crisis was made by different speakers participating in an intersting symposium on "Food and the People organized by the Royal Asiatic Society of Bengal at the instance of the Indian National Commission for Unesco at Calcutta, on July 16, 1949, with Dr A C Ukil in the chair,

Dr B C Guha who initiated the discussion said that there was an overall world shortage in food The problem had been aggravated by the increase of world population It was a double problem and the food problem should be looked at from a viewpoint of agricultural technology by which the crisis that threatened the world today could be effectively averted

Referring to the position in India, Dr Guha said that unless the present system of fragmentation of land was given up and replaced by a united system of co operative farming by scientific methods, the problem could not be tackled As regards substitution of cereal food, he said that in India there was a shortage of 10 per cent in foodgrains Deficiency in other types of food, like egg, milk, meat etc , varied from 100 per cent to 400 per cent So, even if the shortage in foodgrains in India was met, deficiency in food would not be made up For deficiency in other types of food, cheap protein must have to be found out Recent researches indicated that protein obtained from green leaves was not very much inferior to protein obtained from meat etc He, therefore, hoped that a process would be evolved for obtaining cheap protein for food from green leaves and for growing yeast on a large scale which contained 50 per cent protein He also suggested that coal and certain types of fungi should be utilized for production of fats by technological processes

Sri S N Sen, who had recently returned from the Unesco secretariat in Paris, said that out of 36,000 million acres of land available in the world, 4000 million acres were cultivated It meant 2 acres of land per head, whereas according to specialist, 2 5 acres per head were considered necessary to maintain a reasonable nutritional standard But in case of India, only 0 7 acres of land were available per head of the population In case of India it was, therefore, a question of avoiding a major catastrophe in the near future The problem could not be solved without the intensive application of scientific and technological developments to all aspects of agriculture Sri Sen further explained that the principal purpose of Unesco in initiating discussion and debates on Food and People was to create an educated public, which would greatly facilitate the work of governmental and inter-governmental organizations directly engaged in the task of increasing food production

Sri S K. Dey, Secretary to the Agriculture Department, West Bengal said that the task of increased food production, could be grouped as technological, organizational and psychological Introduction of technological measures would result directly in a rise in the soil's yield, but these measures had not gained wide currency The largest single factor responsible for a satisfactory crop outturn was timely and assured supply of water in adequate quantity, absence of which nullified the benefits of good quality seeds, rich manures and efficient implements In a considerable measure, the explanation of the poor results obtained from the services and supplies distributed under the "Grow More Food" campaign must be traced to this defect in the farming technology In West Bengal not more than 13 per cent of the cropped area was served by artificial irrigation and the rest depended entirely on monsoon Production would, therefore, depend overwhelmingly upon the caprices of nature, in spite of whatever might be done by Government

As regards extension of Government s irrigation service, Sri Dey said, that the programme was meeting with increasing resistance, as the users were less and less prepared to pay for the service Irrigation was, therefore, being provided either free or at a price which did not cover the full cost There was no help for it in the present situation when food had to be produced at any cost But this state of affairs could not continue for long without serious detriment to the entire economy As regards use of fertilizers, Sri Dey said that the selling price of fertilizer was calculated at Rs 14/ per maund while controlled price of extra paddy obtained from its use was Rs 15/ per maund The consequence was that, with the decision to charge the full cost to the cultivator from the current year, the sale of fertilizers has suffered a drastic decline and the question of resuming subsidized sales has to be reopened again

Sri Dey said that the limited scale in which production was carried on at present was not suited to the application of improved technique and for large scale farming, overcrowding on land must be relieved by finding alternative occupation for a large percentage of these people The problem of food sufficiency must be viewed in this perspective That problem could not be solved by aiming at producing only what was required for food There must be an increasing surplus over consumption out of which industry could be built, which would, by absorption of the excess labour in agriculture, make room for agricultural expansion itself. The organization of joint enterprise of local groups for the planned development of their areas should receive the first priority in the food production plan

Prof D Ghosh, Head of the Economics Department, Calcutta University, analyzing present food situation in India said that there were large estates which could have been converted into capitalistic farming, but these opportunities had not been exploited and they continued to rely on tiny lands to produce their food What was, however, less familiar was that fragmentation of farming was cutting down the proportion of the total output to what was available for consumption by non farming section of the population The consumption of food bulks large in the budget of the poor family in the country and the lower the income of the average agricultural family and larger the share of the total output produced by such families smaller the amount of produce that was available for disposal to the non farmers 'We are drawing to a crisis which the Soviet economy faced shortly after the dissolution of big estates following the Revolution

Referring to pressure on land, Prof Ghosh said that the pressure on agricultural land in the present social economy would have to be lessened by a rapid and enormous expansion of the non farming section of the economy In the type of economy in which they were living, the growth of population was the heaviest drag on the capacity to grow more food 'We cannot adequately feed ourselves unless we reorganize our economy or restrict our population,' Prof Ghosh added

Sri K C Basak, Director of Economic Research, Indian Central Jute Committee, said that the present problem might ease in the near future not because of more production, but by large scale unemployment as happened during the slump period before the last war He said that nearly 40 per cent of the total income of farmers came from non farmers and with unemployment the source rapidly dried up which compelled the low income group people to purchase less food But this was artificial surplus and the economic characteristics of the population would have to be taken into account for a lasting solution of the problem Other speakers included Sri G M Sen, and Dr K P Biswas

IN QUEST OF URANIUM

With the advent of the atomic age, the search for Uranium ores has become more relentless The Americans are hunting for the precious mineral from Texas to Alaska, particularly on the bleak and lonely Colorado plateau So pressing has been their need, that the Atomic Energy Commission has posted a $10,000 reward for the discovery of each new high grade ore deposit of 20 tons or more The Soviets are likewise combing their vast territory, including the occupied zones astride the borders of Saxony, Czechoslovakia and Polish Silesia The United kingdon has also launched an all out drive to collect the mineral Since Britain happens to have been surveyed more completely than any other part of the world, the 'Uranium rush" is being intensified in the Colonial Empires

Indeed the U K Ministry of Supply offers to buy all Uranium ores and concentrates produced in the Colonial Empire during the period of next ten years at a minimum price of 12s 9d per ℔ (£ 1,540 per long ton) of contained Uranium oxide delivered f o b ocean port No specific offer is made for thorium bearing minerals but the Ministry states that it is very ready to discuss terms for purchase from any would be vendor

In order to stimulate interest for ores of Uranium, the Geological Survey of Great Britain, D S I R (Atomic Energy Division) has issued a short technical pamphlet entitled "*A Prospector's Hand book to Radio active Mineral Deposits*' The pamphlet is published by H M S O, price 6d (20 cents U S A) It provides the fundamental scientific information necessary to guide prospectors, geologists and engineers in their widespread search for Uranium bearing minerals The Atomic Energy Division of the Geological Survey undertakes to assay and report on samples of Uranium ore encountered during explorations in those countries from which the British Govt might draw supplies

The Ministry of Supply will also, in appropriate circumstances, give grants towards the development of producing mines and for the erection of extraction plants

S D C

ACTION OF POLYPHOSPHATES

A new theory to explain the action of polyphosphates in promoting full dispersions in water of clay and similar substances has been put forward by Dr John Van Wazer, before the 23rd national colloid symposium of the American Chemical Society The action of the polyphosphates, of which the most effective were those corresponding with sodium phosphate glass, was to break down the attractive forces which bind together clay particles into tangled rope like structures when suspensions in large quantities of water are made Dr Wazer also helped to explain the important role of polyphosphates with reference to the basic behaviour of clay particles The polyphosphates have become extremely useful in industry for thinning clay and pastes They are added to drilling muds, the clays used to lubricate oil well drills and to float away the rock as it is cut by the drill They are also employed to thin pastes of titanium dioxide and a wide variety of viscous materials

Dr Wazer noted that his experiments showed that fine particles of clay, mixed with just enough water to make a workable paste, are held together by surface tension When more water is added, the particles form the widely separated rope-like structures, the surface tension of the water holding the ropes together In the presence of polyphosphates, the attractive forces are overcome and a relatively even dispersion is brought about (*The Chemical Age*, June 25, 1949)

NEW VACUUM PROCESS FOR ALLOY CASTING

A new vacuum process for refining and casting, which holds promise of increasing the versatility of high strength alloy of steels and other metals, has been developed by the Vacuum Casting Corporation, Philadelphia, U S A Owing to the importance of high strength alloys in defence production, the new process has been kept secret It is claimed that this vacuum casting method provides a revolutionary series of improvements in the metallurgical electrical and physical properties of cast metal

The major applications for the new process are in the casting of ingots and in precision casting of finished parts High strength alloys of steel cast from the melt by the new process can be given far greater ductility than at present, making them suitable for a variety of forming operations other than forging Under this new process, nitrogen present in the atmosphere is eliminated by casting metals in a vacuum, thereby avoiding nitrogen combining with alloys to form nitrates which give brittleness to the finished castings, as in existing casting methods Compressors for jet engines it is claimed, ordinarily made from scarce cobalt alloys, can by the new vacuum method be precision cast from other alloys (*The Chemical Age*, June 4, 1949)

RADIOACTIVITY EFFECTS ON HEREDITY

Groups of thoroughbred, early maturing trout have been studied intensively through three succeeding generations at the Applied Fisheries Laboratory of the University of Washington The groups were bombarded with varying intensities of X Rays, which are similar to the gamma rays from atomic explosions The studies show that the larger the dosage of radiation received by the first generation, the more descendants will die or develop abnormalities In succeeding generations, the rate of survival is lower and the incidence of abnormalities increases, even among descendants of trout that received only small doses Large numbers of eggs from irradiated ancestry are infertile In others the embryo dies during incubation or soon after hatching A large percentage of those that hatched had bone and nervous defects

According to the director, Dr Lauren R Donaldson, "Translated into terms of human beings, the research thus far indicates that the grand children of Nagasaki and Hiroshima survivors will be less fertile than normal parents and will produce more stillborn or misshapen offspring if they have any families at all " (*Chemical and Engineering News*, May 16, 1949)

STUDY OF ARCTIC AREA

The ornithological life of the Arctic area 200 miles south of the north magnetic pole will be studied this summer by the government sponsored Perry River Expedition, which is to leave Edmonton, Alberta on May 17 The team of three scientists includes Peter Markhan Scott, waterfowl painter and director of the Seven Wild Fowl Trust—and two representatives of the U S Fish and Wildlife Service—Paul Queneau, research ornithologist of Westport, Connecticut and Harold C Hanson of the Illinois Natural History Survey They will observe the flora and fauna of the region and make an intensive study of five fowl, the American brant the black brant, the Ross goose, the tule goose and the white fronted goose The team will be joined by Eskimo guides at Victoria Island in the Arctic and will push 150 miles with dog sleds across the ice James Bell Canadian bush pilot, will join the expedition in July when the thaw permits him to land his small plane (*Science*, May 13, 1949)

TITANIA CRYSTALS AS GEMS

Titania Crystals said to be the only substance in existence more brilliant than diamonds are being sold in boule form in limited quantity to the gem field to test their appeal and market potential as gems The price in boule form before cutting is 50 cents a carat for the clear and 75 cents a carat for the blue and amber crystals Titania gems were found as an 'accident of research at National Lead Co The company scientists while studying with greater accuracy the optical and electronic properties of titanium dioxide pigment obtained crystals of beautiful gems

The index of light refraction of the stones is about 2 70, as compared with the less brilliant 2 41 of a diamond They are far below the diamond in hardness, however with a hardness index of 7 on the Mohr s scale, as compared to 10 (*Chemical and Engineering News*, May 23, 1949)

PREGNANCY TESTS HUMAN AND BOVINE

Doctors in this country depend upon an Aschheim Zondek or a Friedman test for diagnosis of doubtful pregnancy and other related conditions The test requires the use of female rabbits and mice and it is both expensive and time consuming Very few laboratories in India are set up for running these tests

Recent reports show that the pregnancy test can easily be performed by using males of frogs and toads in all countries alike, and these, it is presumed, may replace mice and rabbits as pregnancy test animals This newly born test is particularly characterized by its speed of reaction, reliability and economy

The test, it is reported, is becoming increasingly popular in Hospitals and Clinics in U S A , and gaining grounds in U K and the continent

The common Indian toad (*Bufo melanostictus*), as well as some frogs (*Rana*) extant in Calcutta, gave good results in tests reported by J L Bhaduri and N R Bardhan of the Department of Zoology, University of Calcutta (*Science, 109*, 517, 1949)

The test is simple and easy to perform, and requires no special equipment It consists of injection of (untreated) urine from a woman into a male frog or toad If the animal responds by a rapid release of spermatozoa, the woman is pregnant Bhaduri and Bardhan claim the positive reaction to be only 25 minutes in majority of early cases

Further experiments with this test are being continued by Bhaduri and his collaborators in their laboratory at 35, Ballygunge Circular Road, Calcutta 19 Medical men should find this practical toad test to be of invaluable help in clinical emergencies and other gynaecological practices

Furthermore, an important announcement by Bhaduri and Bardhan for a new toad test for bovine pregnancy, which will be welcome by the Veterinary Doctors, is published elsewhere in this issue (*See* p 76)

ARTIFICIAL INSEMINATION TO ACCELERATE CATTLE POPULATION

One of the most amazing experiments ever attempted is nearing fruition at the School of Agriculture at Cambridge A cow there will, in a few months, give birth to a calf of which she is not the real mother

By using hormones and artificial insemination Dr Hammond, Director of the School and his helpers have discovered means of making one prize cow have as many as 20 calves at one time The prize cow does not give birth to the calves herself While they are still in the egg stage—no larger than pin points—they are taken away from her and injected into a score of other cows which act as foster mother while the calves develop

The cow at Cambridge would not take any prizes but the calves she is to produce will, because both parents were of the finest stock

This new development holds tremendous possibilities Cows which cannot give more than a few pints of milk daily can be made to produce calves which will grow up to give yields of six or seven gallons daily This will make it possible to improve cattle strains even faster than has been proved possible by artificial insemination where improvement from the male side is limited by the nature of the cow

Even more remarkable methods are being evolved for increasing and improving the world's animal population Research workers at Cambridge found that many animals judge whether or not it is mating time by the length of daylight They experimented with various animals and found that sheep could be deceived by artificial lighting into having lambs well out of season They believe that it is possible to make sheep have lambs twice a year instead of once and that if means could be found to apply the system on a large scale it could contribute greatly to the prospects of making a rapid increase in the world sheep population

The results of the valuable work being done at Cambridge are available to all the world (I C I Veterinary Department, *Veterinary Bulletin*, February 1, 1949)

FIELD TESTS WITH COMPOSTS INCORPORATING HUMAN FAECES

A series of studies is described by J C Scott, Soils Dept, Cheeloo University, Tsinan, Shantung, China, in which composts incorporating human faeces were tested on various crops together with inorganic fertilizers These were carried out at Tsinan, N China The main conclusions from these experiments are

1 City compost, faeces cake, and ammonia sulphate are quick acting nitrogen carriers, farm compost and pig pen manure are slow acting nitrogen carriers

2 Farm compost gives the same response as pig pen manure for much less faeces used It would probably give more for the same amount of faeces,

3 Faeces cake give a much larger response than pig pen manure for about the same amount of faeces Its nitrogen seems to be more readily available,

4 City compost seems to give highest returns per unit faeces used,

5 Limiting factors seem to be mainly moisture and nitrogen,

6 Nitrification studies accord well with crop tests,

7 The different fertilizer treatments do not appear to have had any influence on the moisture holding properties of the soil (*Empire Journal of Experimental Agriculture, 17*, April, 1948, pp 73-81)

PLACEMENT OF FERTILIZER FOR POTATOES

G W Cooke of Chemistry Dept, Rothamsted Experimental Station, Herpenden, Herts, observes In 29 experiments conducted in 1945, 1946 and 1947 placement of fertilizer in contact with the seed or in two bands each 2" away and 2" below the level of the seed gave average yields similar to those given by the standard practice of broadcasting after ridging but before planting Placement in one hand 2" below the seed was tested in 4 experiments and proved inferior to other placement methods and to broadcasting over the ridges

Broadcasting fertilizer before ridging was compared with broadcasting after ridging in 25 expts in 1946 and 1947 Applications made after ridging were consistently superior to those made before ridging The general relationship that 10 cwt per acre of fertilizer broadcast before ridging were required to produce average increase in yields equal to those given by 7 cwt per acre broadcast after ridging

Observations on the growing crops revealed no harmful effects of fertilizer placed in contact with the seed in 1945 and 1946. In 1947, however, at several centres growth was severely checked by heavy dressings placed in contact with the seed and the final yields were below those from fertilizer placed inside bands which caused no early check

This work was carried out under the auspices of the Agricultural Research Councils' Conference on methods of fertilizer application to agricultural and horticultural crops and with the aid of a grant from the Council (*Journal of Agricultural Science, 39*, January, 1949, pp 96-103)

CONTROL OF ALASKAN MOSQUITO ADULTS BY AERIAL SPRAYS

This work was conducted, under funds allotted by the Dept of National Defence to the Bureau of Entomology and Plant Quarantine, by F S Blanton, C N Husman, B V Travi and C S Wilson

Large scale spray tests in Alaska showed that the infiltration of mosquito adults into plots 24 to 30 square miles in area is sufficiently rapid so that the plots must be re-treated about every 7 to 10 days during the peak of the mosquito season When only 4 square miles were treated, infiltration of annoying numbers of mosquitoes occurred within 48 hours Fair protection of the large area was obtained with four sprayings during the season The mean initial reduction with dosages of 0 4, 0 1 0 05, and 0 025 pound of D D T per acre were, respectively, 92, 83, 80 and 30 per cent Except for one test under unfavourable wind conditions, the average reduction for the 0 1 pound dosage was 92 per cent instead of 83 per cent The dosage of 0 1 pound of D D T is considered adequate if applied under suitable wind conditions (*Journal of Economic Entomology, 42*, February 1949, Pp 106-109)

MULLITE

Successful synthesis of single crystals of *Mullite*, a silicate rarely found in nature but occurring in the firing of certain ceramic materials is announced by by W H Bamer and J Gordon A new approach to silicate technology is suggested with the possibility of synthesizing commercially important silicates such as tourmaline, used in sonic detectors and electrical frequency controls (*Science, 109*, May 1949, p 503)

FAMOUS OBSERVATORIES INVITED TO AUSTRALIA

The Australian Government has invited four universities—two in the United States, one in Sweden and one in Holland—to establish observatories at Mount Stromlo, near Canberra, Australia's federal capital

The universities are Columbia and Yale (U S A), Uppsala (Sweden) and Leyden (Holland) Three of them, Yale, Columbia and Leyden, have observatories at Johannesburg (South Africa) for the study of stars in the Southern Hemisphere but smoke haze from heavy industry is making their work difficult there and they are thinking of moving The other university, Uppsala (Sweden) is considering setting up an observatory in the Southern Hemisphere

Mount Stromlo (2,600 ft), is the site of the Australian Commonwealth Observatory, has natural advantages hardly shared by any other observatory in the world—including an astronomically first-class sky In 1947 there was a continuous spell of 14 astronomically perfect clear days in succession—a phenomenal record

Mount Stromlo Observatory is to be equipped with a 74 inch reflecting telescope, now being built in England When it is installed Mount Stromlo will be one of the world's biggest observatories, fifth in order of telescopic power

Mount Stromlo's director is Dr Richard Woolley, a student of late Sir Arthur Eddington He worked at the Mount Wilson Observatory in California for some time He was chief assistant at Greenwich to Sir Harold Spencer Jones, the Astronomer Royal In 1939 he was appointed to his present post of Director of the Australian Commonwealth Observatory

THE INTERNATIONAL GEOGRAPHICAL CONGRESS

The Sixth International Geographical Congress was held at Lisbon on April 8th and 15th The Congress brought together 330 geographers from some 30 countries

The private and professional character of the International Geographical Union was re affirmed although in a number of cases the dues for membership were paid by the Government During the Congress an important decision was taken in regard to the future election of membership to the Congress At present the membership is through a series of national committees each appointed by the principal scientific bodies or national research councils, which serve as the adhering organizations The proposed change in the statutes provides for new voluntary basis of membership in which each country elects to join one of the 8 categories with a graduated series 1 to 15 units for the dues Until the time of the next Congress each unit has been fixed at $100 The former basis for graduated voting was abolished so that in administrative matters each national committee has an equal vote

The principal activities of the Union between the sessions concerned are operation of a series of commissions of which 13 were appointed at Lisbon These range from problems on population, sports, land use and medical geography to periglacier morphology, soil erosion, terraces and aeral photo interpretation.

Dr George B Cressey, Chairman of the Department of Geography at Syracuse University was elected President and Dr George T K Kimble of the McGill University, the Secretary of the Seventh International Geographical Congress which will be held in the U S A in 1952 The 9 newly elected officers were chosen from 9 countries with representatives from Asia and Latin America

HOUSING OF THE SCIENTIFIC AND TECHNICAL SOCIETIES IN CALCUTTA

A proposal has been sponsored by the *Mining Geological and Metallurgical Institute of India* (the oldest specialist scientific society established in India), for the housing of the offices of the scientific and technical societies in a central locality in Calcutta The proposal envisages the provision of an attached well equipped scientific and technical library, a science museum, an appropriate number of lecture and meeting rooms and also temporary residential accommodation to visiting members and other eminent scientists and specialists from different parts of India and overseas Under such a scheme, the disabilities which many of the institutions now suffer from would be largely removed, and better scope would be available for the informal discussion and solution of many problems which have arisen and will arise in the scientific and technical fields It will also be possible to bring about frequent joint discussions of specialists representing the different sciences to effect a better appreciation of each others' views and scope of work and the widening of the horizon of scientific knowledge, by removing the barriers which tend to confine the specialists to working in water tight compartments

The representatives of the scientific societies and learned bodies who met to consider the proposal have been unanimous in their support and a committee has been formed to suggest ways and means of implementing the proposal

Among the institutions whose support has already been obtained are *Indian Science Congress Association*, *Indian Institute of Chemical Engineers*, *Indian Institute of Metals*, *Zoological Society of Bengal Geological, Mining and Metallurgical Society of India Botanical Society of Bengal*, *The Mining Geological & Metallurgical Institute of India*, *Bangiya Bijnan Parishad*, *Science Club, Calcutta Physiological Society of India*, *and Indian Science News Association*

In addition the following societies are also giving consideration to the matter *Royal Asiatic Society of Bengal and Indian Chemical Society*

The National Institute of Sciences of India has nominated a representative to take part in the joint deliberations of the societies,

INDIAN ASSOCIATION FOR THE CULTIVATION OF SCIENCE

The annual general meeting of the Indian Association for the Cultivation of Science was held at Calcutta, on July 23 1949 In the absence of the President Prof M N Saha, Sri C C Biswas, a Vice president of the Association, presided

Presenting the annual report of the Association for 1948 49, Prof P Rây, Hony Director, referred to the progress made towards the construction of the new research laboratories at Jadavpore, the laying of the foundation stone of which took place on September 26, 1948 (See SCIENCE AND CULTURE, December, 1948, p 234) The Association was anxious to see the laboratories removed to the new premises as early as possible, the immediate programme was, therefore, the construction, equipment and fitting of the ground floor of the building

Referring to the research activities, he said that the three existing research departments, *e g*, X rays and Magnetism, Optics, and Physical Chemistry, functioned as in the previous year The Department of X rays and Magnetism concentrated their investigations on the study of extra reflections in Laue photographs, X ray study of glass, study of the magnetic properties of single crystals and of solutions containing para magnetic ions study of electrical and magnetic properties of semi conductors, construction of magnetic and electrical apparatus, and production of low temperature Researches in the Department of Optics included the study of Raman spectra and *cis trans* isomerism Raman spectra of substances in different states Raman spectra of organic vapours fluorescence of organic compounds, structure of resonance line of mercury filtered through mercury vapour Brillouin components in crystals and luminescence and absorption of different varieties of diamond The Department of Physical Chemistry reported investigations on the following lines fundamental studies on polymerization kinetics, inhibition and retardation of vinyl polymerization, chain transfer by solvents in vinyl polymerization cellulose chemistry including benzyl cellulose and acetyl cellulose, trial experiments on the preparation of alkyd resins from Indian raw materials, solubilization phenomenon solubility and co solvency of metallic soaps kinetics of α halogenation of fatty acids, and dielectric behaviour of high molecular weight substances

During the year under review, efforts were made to bring into existence the proposed new Departments of Theoretical Physics and Organic Chemistry But owing to the failure of securing the services of a suitable theoretical physicist and an organic chemist their creation had to be postponed till the next year

Professor S Chapman delivered the *Ripon Professorship Lectures* of the Association on the 'The Magnetism of the Earth on January 14 and 15, 1949 The

Mahendralal Memorial Lecture was delivered on February 23 by Dr B S Guha on The Aboriginal Tribes and their places in Indian National Life (See SCIENCE AND CULTURE May 1949 p 447)

Concluding the Hony Director reported that the Association received from the Govt of India a capital grant of Rs 4 32 000/ towards the construction of the new research building a recurring grant of Rs 2 66 700/ (together with the second instalment of Rs 89 000/ due for 1947 48) and a special contribution of Rs 10 405/ towards the dearness allowances The Council of Scientific and Industrial Research made a grant of Rs 13 212 14 6 for X ray studies of metals and alloys and of Rs 6 419/ for like investigations on coal The Indian Physical Society contributed a sum of Rs 700/ towards the *Indian Journal of Physics* The Director further announced that the Government of West Bengal were pleased to make a grant of Rs 2 00 000 towards the construction of the new Research Laboratories and thanked the Government for their act of generosity for the cause of scientific development

The budget estimates of the Association (general funds—recurring) for 1949 50 show a receipt of Rs 2 95 000/ and an expenditure of Rs 2 99 400/

The Chairman presented the *Woodburn Medal* to Dr Shyamadas Chatterji of the Bose Research Institute Calcutta for original research in Physics *Nikunja Carabani Prize* to Sri Ranjit Kumar Sen and *Jatindra Chandra Prize* to Sri Ajit Kumar Dutta for best researches carried out in the Association

The following were duly elected or nominated office bearers and members of the Council of the Association for 1949 50

President Prof M N Saha *Vice Presidents* Sri C C Biswas and Dr J C Ghose *Hony Director* Prof P Ray *Members* Sri D C Chakrabartti Dr S R Bose Dr B C Guha Sri S C Ganguly Sri J M Majumdar Dr K N Mathur Prof S K Mitra Prof H K Mookerjee Prof P C Mahanti Prof S K Ray and Rev Fr A Verstraeten *Trustee Member* The Hon ble Justice Sri Ramaprasad Mookerjee *Nominees of National Institute of Sciences of India* Dr D S Kothari and Dr B B Dey *Nominees of the Government of India* Secretary Department of Scientific Research (or his nominee) and Educational Adviser to the Govt of India (*Ex officio*) or his nominee Accountant General Govt of West Bengal *Nominee of the Government of West Bengal* Dr D M Sen *Professor Member* Prof S C Sirkar

DR P B SARKAR

Dr P B Sarkar Senior Research Chemist Technological Research Laboratories Indian Central Jute Committee has succeeded Mr C R Nodder as Director of this institute

Dr Sarkar had a brilliant academic career and obtained his doctorate in 1936 for his researches on the chemistry of lignin He has published numerous research papers on jute in scientific journals of India and abroad and is a regular contributor of popular scientific articles in leading magazines

Prior to his joining the Jute institute in 1939 Dr Sarkar was a Professor of Chemistry at the Vidyasagar College Calcutta and is author of a Text book on Organic Chemistry and Intermediate Practical Chemistry

In 1948 Dr Sarkar was deputed by the Indian Central Jute Committee to study the recent developments in fibre technology with special reference to jute in U K and U S A where he spent about six months for the purpose

Dr Sarkar was elected a Fellow of the National Institute of Sciences of India in 1946

ANNOUNCEMENTS

Professor J Kreidel Director of Research in the firm of Bausch and Lomb U S A is appointed Director of the Central Glass and Ceramic Research Institute Jadavpur near Calcutta

Mr C R Nodder Director of the Technological Research Laboratories Indian Central Jute Committee has been appointed Principal Institute of Jute Technology Calcutta University

Sri A K Paul Assistant to the Agricultural Adviser to the Government of Aden and Tobacco Specialist to the Government of Makalla South Arabia is appointed Assistant Botanist Jute Agricultural Research Institute Hooghly

Sri H S Puri formerly of the Burmah Oil Company (India Concessions) Limited has been awarded graduate assistantship by Louisiana State University at Baton Rouge to enable him to do research on Micropaleontology He will also work at the Department of Micropaleontology of the American Museum of Natural History at New York the United States Museum at Washington and the Paleonotogical Institute at Ithaca

LETTERS TO THE EDITOR

[The Editors are not responsible for the views expressed in the letters]

THE LIMITS OF UPPER KHIRTHAR IN THE INDIAN REGION*

The Eocene subdivisions in North West India (now Western Pakistan) established by early workers were not clearly defined and in most cases no reference is made to the type area Later classification based on old versions has gradually led to a great confusion in correlation and often a facies change of local or geographic value have been considered as stratigraphic and hence has been taken as basis of time subdivisions

Davies[8] while discussing the subdivisions in the Khirthar series has quoted evidence which indicates the existence of Vredenburg's Upper Khirthar as a faunistically distinct Zone of the Indian Eocene and has advocated the acceptance of the Spintangi Section as the locality for the Upper Khirthar beds of India and has also recalled the main facts regarding the Eocene sequence there which Oldham sub divided in descending order into Dunghan Limestone Ghazij Shales and the Spintangi group Davies (*loc cit*) has suggested the abolition of the term Dunghan Limestone since in the Dunghan mountain it contained strata of Upper Cretaceous Ranikot and Laki ages and to adopt the term Harnai Limestone and Bolan Limestone for the Ranikot and Laki components of the Dunghan Limestone Davies proposals were however not acceptable to Evans (in Davies[8] p 229) Since in his opinion the Upper Khirthar appeared to have two type localities the Khirthar Range in Sind and the Spintangi section in Baluchistan and suggested that it would be of considerable interest to compare the fauna of the Khirthar Range with the Spintangi area further north Evans (*loc cit*) did not accept Davies suggestion to rename the Dunghan Limestone and said that the inclusion of Cretaceous and Laki Limestones in the Dunghan was due to an error and that true Dunghan Limestone had widespread development and that the term was firmly established in India and serves as a useful lithologic unit although it represented strata of both Ranikot and Laki ages Apart from these considerations the succession of the Khirthar at Spintangi does not appear to be as complete as in other areas (*e g* Mula Pass)

The problem which in itself is by no means an easy one leads to several other controversial points in the correlation and classification of the Khirthar We are at the present confronted with the main issue —does Vredenburg's Upper Khirthar stage with a distinct fauna exist or is its fauna a result of changes in facies? If Vredenburg's idea of an Upper Khirthar Zone has some foundation what Khirthar fauna, if any, can be said to succeed Nuttall's 'Middle Khirthar"?

Davies (*loc cit*) who described the principal contents of the latest Eocene beds at Spintangi has quoted evidence which could be said to succeed Nuttall's Middle Khirthar He showed that *Nummulites millecaput* Boubee appears at the base of this Zone (his beds 10 12 which he provisionally regarded as representing Upper Khirthar) and *N beaumonti* D Archiac and Haime near its top According to Vredenburg the lowest Zone of his Upper Khirthar contain *Assilina spira* and *N perforatus* which continues into the second while the third Zone contained *N complanatus* Davies thinks that Vredenburg's *A spira* may probably be *A irregularies* his *N perforatus* may indicate *N uroniensis* or *N obtusus* or both and his *N complanatus* may be *N millecaput* All these species characterize the Kohat Limestones and Davies is of the opinion that Kohat Limestones represent Vredenburg's lower three zones of the Upper Khirthar Vredenburg's fourth and highest Zone which is said to contain *N ? biarritzensis* which Davies regards as probably be the same as *N beaumonti* and *N ? brongniarti* which according to Davies may be the associated *Dictyoconcoides* (*D Kohaticies* var *spintangiensis*) Thus Davies conception of Upper Khirthar is narrower than Vredenburg's as he has excluded the Kohat Limestones since it is only at the close of Kohat Limestones that faunistic facies become separable from that of the Middle Khirthar

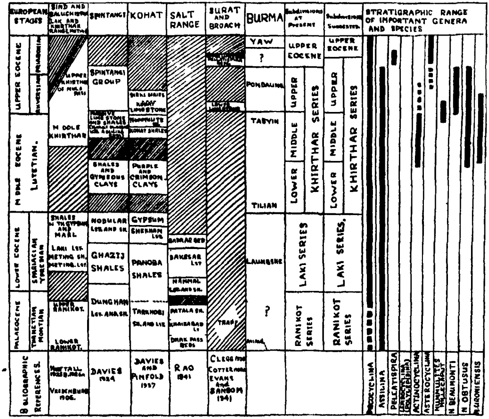
Rao[17] has described a Lower Priabonian fauna from the *Pellatispira* bed of Surat and Broach in Western India—a horizon which is intermediate between Davies Upper Khirthar at Spintangi in North West India and the Yaw stage (Upper Priabonian) of Burma in which the earliest *Lepidocyclina* existed side by side with the last *Discocyclina*—a horizon absent in North West India since there is a stratigraphical break between the Upper Khirthar (Auversion) and the Lower Nari (Rupelian) If we are to accept Davies restricted version of Upper Khirthar where are we to fit in the *Pellatispira* bed which has yielded *Discocyclina cf dispansa D cf javana Pellatispira madaraszi* var *indica P inflata* var *minor P orbitoidea* and small *Nummulites* There are two possible alternatives —extension of the Upper Khirthar upwards to include the Lower Priabonian *Pellatispira* bed or creation of a new series for the reception of these post Khirthar beds If a choice must be made between the two alternatives the writer is inclined to select the first—extension of the otherwise narrowed Upper Khirthar to include the *Pellatispira* bed rather than complicating the existing classification of the Eocene by proposing new name for the reception of the *Pellatispira* bed The accompanying table shows the proposed classification and its correlation with different sections which is intended to serve as a working basis and should not be taken to apply *senso stricto*

With the progress of our knowledge it has been realized that the original classification of the Khirthar of the Indian region does not provide a satisfactory basis for correlation The Upper limit of the Upper Khirthar should be extended to include the Lower Priabonian *Pellatispira*-bed of Surat and Broach which represents an intermediate position between Davies' "Upper Khirthar" Spintangi Limestone and the *Lepidocyclina-Discocyclina* bearing Upper Priabonian Yaw Stage of Burma This, it is expected, will provide basis for correlation to serve our present needs until some detailed results are forthcoming

TABLE

CORRELATION OF THE EOCENE IN THE INDIAN REGION.

(NOT TO SCALE)



H S PURI

Calcutta, 17-5-1949

---

*Indian region is dealt here as a geographic and not as a political unit and includes territories now under Pakistan and Burma.

[1] Blanford, W T. *Mem. Geol Surv Ind. 20,* 1883

[2] Carter, H. J. *Ann. Mag Nat Hist 8* 374 and 446 50, 1861

[3] Clegg, E. L. G. *Mem. Geol Surv Ind 72* (2), 1938

[4] Cotter, G. de P *Rec Geol. Surv Ind 44,* 52-8 . 1914.

[5] ———*Reg. Geol. d Erde, 1,* (6), 1933B.

[6] Davies, L M *Jour Asiat Soc Bengal* N S. *20,* 207, 1924.

[7] ———*Trans. Min Geol Inst. India, 21,* 313, 1927

[8] ———*Quart Jour Geol Soc* London, *36,* 199 230, 1940

[9] ———and Pinfold, E S *Pal Indica,* N S *33,* 1937

[10] Evans , P and Sansom C A *Geol Mag 78* (5), 321 350, 1941

[11] Holland, T H *Mem Geol Surv India, 51* (1), 1926

[12] Nuttall, W L F *Ann Mag Nat Hist* Ser 9 *16* 378, 1925A

[13] —— *Geol Mag 63,* 495 1926B

[14] Oldham, R D *Rec Geol Surv India, 23* 57, 1890A

[15] — ——*Rec Geol Surv India 25* 18, 1892

[16] Pinfold F S *Rec Geol Surv India, 49,* 137 1918

[17] Rao S R N *Jour Mysore Uni* Sect B, *2* (2), 5 17 1941

[18] Rao S R N *Rec Geol Sur India 77,* Professional paper, 12, 1942

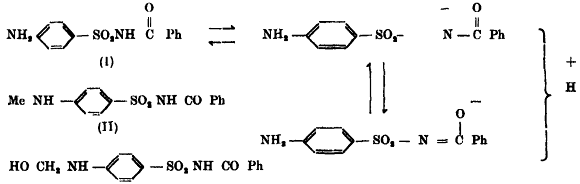
[19] Vredenburg, E W *Rec Geol Surv India 34* 79, 1906A

[20] ———*Pal Indica,* N S *3,* (1), V 1909B

SULPHANILYLBENZAMIDE AND ITS N⁴ SUBSTITUTED DERIVATIVES

Abundant evidence has now been accumulated to show that the chemotherapeutic action of a sulfa drug is due to its competition with substances associated with the enzyme systems of the pathogenic organisms, and the drug action is being believed to be brought about by combination with the enzyme system (*cf*, Woods[1] and Sevag[2]) Naturally it may be expected that the activity of any particular compound would depend on its solubility, distribution, dissociation, conjugation, or metabolic disintegration in the system No definite correlation has yet been established between the above properties and the structure of the compound, still as maximum bacteriostatic activity is generally found to occur among those drugs whose p_{ka} is close to the physiological *p*H[3,4], a systematic study on the effect of change of structure in a sulfa compound may be of interest in order to find out the relationship between pka and the activity at least in ionizable sulphonamides

In this laboratory Sulphanilyl benzamide (I) is being studied from various angles[5,6,7,8] Here the ionization would be favoured by the possibility of resonance of the ionic form as well as by the electron attractive character of the benzoyl group Ordinarily it may give rise to the following ions

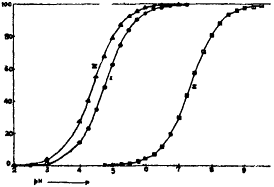


(I)

(II)

(III)

On methylating a silver salt of the compound in a non polar solvent like benzene a N^4 methyl derivative (II) was isolated[6] A N methyl derivative, however, may undergo demethylation in the system and may exert the characteristic reaction of the mother compound



Figure

Similarly a N^4 hydroxy methyl derivative (III) of sulphanilyl benzamide too has been found[10] to exert bacteriostatic action against intestinal organisms It would be of interest to study the relative activities of these three compounds *in vivo* In the meantime the acid dissociation exponents (pka) have been determined by potentiometric titrations and the percentage of ionization (K) has been calculated for different *p*H values These values are being recorded in the Table below and the percentages of ionization have been plotted against *p*H in the Figure

TABLE

Compound	pka	k
Suphanilyl benzamide mp 180° (I)	4 78	$1\,68\times10^{-5}$
N^4 Methyl Derivate M P 204 205°(II)	7 37	$7\,08\times10^{-8}$
N^4 Hydroxy methyl Derivative m p 160° (III)	4 43	$8\,76\times10^{-5}$

It may be noticed from Curve (II) in the Figure that at *p*H 7 37 the N^4 methyl sulphanilyl benzamide (II) is 50 per cent ionized As sulphanilyl benzamide (pka 4 78) itself is very active against bacillary dysentery organisms, and as its other N^4 derivative (III) is also not inactive, it would be of more interest to study the bacteriostatic activity of this N^4 methyl sulphanilyl benzamide with pka 7 37 (*cf* Klotz and Gutmann[11]) against different organisms

The authors wish to express their sincere thanks to Mr K R Chandran for preparing a sample of N^4-methyl derivative and to Mr S Mukherji for his valuable criticisms

R BHATTACHARYA
U P BASU

Bengal Immunity Research Institute,
Calcutta, 24 5 1949

[1] Woods, D D, *Brit J Exp Path*, *21*, 74, 1940
[2] Sevag M G, *Adv Enzymol.*, *6* 33, 1946
[3] Klotz, I M, *J Amer Chem Soc*, 66, 459, 1944
[4] Bell, P H and Robbin, R O, *ibid*, *64*, 2905, 1942
[5] Sikdar J and Basu, U P, *J Ind Chem. Soc*, *22*, 343, 1946
[6] *idem*, p 348, 1946
[7] Bose, A N and Ghosh, J K, *Ind, J Med Res*, *32*, 61, 1944
[8] *idem*, *Current Science*, *14*, 38, 1945
[9] Lewis, R, and Morris T, *Chem. Abs*, 35, 198, 1941.
[10] Basu, U P, *J Ind Chem Soc*, *26*, 130, 1949
[11] Kloz I M and Gutmann, H R, *J Amer Chem. Soc*, *69*, 473, 1947

ON THE FOOD AND FEEDING HABITS OF THE LEOPARD POMPHRET, *SCATOPHAGUS ARGUS* (PALLAS) AND THE POSSIBILITY OF ITS CULTURE NEAR THE ESTUARIES OF BENGAL

Previous workers like Devanesen[1,2], Hornell and Nayudu[3], Job[4], John and Menon[5], and Southwell[6] and others contributed something towards the food and feeding habits of the coastal fishes of Indian waters but nothing was known of the nature of the food and feeding habits of the estuarine fishes until the works of Mookerjee, Ganguly and Sircar[7], Mookerjee, Ganguly and Mazumdar[8], and Mookerjee Ganguly and Pakrasi[9] were published In continuation of the series the nature and quantity of the different items of food found in the stomach of the fish Leopard Pomphret, *Scatophagus argus* (Pallas) during the different stage of its life history along with the feeding habits of the fish are dealt in this note

Various stages of the fish were collected during the years 1945 46 from different places in the estuarine areas of Bengal like Port Canning, Diamond Harbour, Kolaghat and Basantia *abad* The specimens were fixed on the spot in 20 percent formalin and finally stored in 4 percent formalin for future use The preserved specimens were brought to the laboratory for study where a thorough investigation on the stomach contents of 402 specimens of different size and collected time to time from different localities were made following the technique adopted by Pearse[11] (cited by Breder and Crawford[12]) The specimens were arranged in six groups according to the quality and quantity of the diet they prefer

The food stuff recovered include unicellular algae, multicellular algae, higher plants, protozoa, sponges, crustacea, fish scale, and sands and mud The details of number of specimens examined, sizes included in each group and the percentage composition of the different items found in the stomach contents are given below

Group A—Stages between 8mm and 11mm

No of specimens examined—45

Percentage of different items found in the stomach—Unicellular algae—42 to 45, Multicellular algæ—40 to 41 Sands and mud—15 to 17

Group B—Stages between 12mm and 18mm

No of specimens examined —57

Percentage of different items found in the stomach—Unicellular algæ—42 to 44, Multicellular algæ—38 to 40 Higher plants—1 to 2, Protozoa—0 to 3; Sands and mud—13 to 16.

Group C—Stages between 21mm and 30mm

No of specimes examined—43

Percentage of different items found in the stomach—Unicellular algæ—32 to 38, Multicellular algæ—55 to 56, Higher plants—1 to 3, Protozoa—2 to 3, Sponges —0 to 2, Sands and mud—2 to 5

Group D—Stages between 35mm and 45mm

No. of specimens examined—55

Percentage of different items found in the stomach—Unicellular algæ—30 to 31, Multicellular algæ—48 to 59, Higher plants—3 to 4, Protozoa—3 to 4, Sponges—0 to 2; Crustacea—0 to 1, Fish scale—1 to 4, Sands and mud—3 to 4

Group E—Stage between 50mm and 64mm

No of specimens examined— 75

Percentage of different items found in the stomach—Unicellular algæ—13 to 28, Multicellular algæ—30 to 35, Higher plants—5 to 10 Protozoa—4 to 8, Sponges—5 to 10, Crustacea—3 to 8 Fish scale— 6 to 12, Sands and mud—4 to 6

Group F Stages between 70mm and 136mm

No of specimens examined 127

Percentage of different items found in the stomach—Unicellular algæ—14 to 24 Multicellular algæ—38 to 50, Higher plants—5 to 8, Protozoa—7 to 10, Sponges 1 to 8 Crustacea—2 to 8, Fish scale— 12 to 16 Sands and mud—0 to 5

Besides the quantitative analysis of the food, an attempt has been made to identify the flora and fauna which form the bulk of the diet The recognizable organisms found in the stomach contents are given below

PLANTS A CRYPTOGAMS Diatomales *Navicula Cymbella, Fragilaria Coscinodiscus, Synedra*, Myxophyceae—*Oscillatoria Lyngbya Phormidium, Anabaena, Nodularia Spirulina, Nostoc, Merismopedia, Schizothrix, Stigonema, Microcoeleus*, Chlorophyceae *Pleurococcus Scenedesmus Ankistrodesmus Coelestrum, Ulothrix Microspora, Cladophora Oedogonium, Spirogyra Mougeotia Micrastias Rhizoclonium Closterium Cosmarium*, Charophyta —*Chara, Nitella*,

B PHANEROGAMS Monocotyledous *Elodea, Potamogeton*

ANIMALS— PROTOZOA CILIATES *Euplotes, Stylonichia, Chaenia, Amphisia, Pleurotrichia, Colpidium*, CRUSTACEA Cladocera-*Daphnia, Ceriodaphnia, Bosmina* Ostracoda *Cypris*, Copepoda *Cyclops*, Copepod nauplius, Amphipoda *Gammarus*

The following generalizations were made on the feeding habits of *Scatophagus argus* from the present study

1 The fish is omnivorous but it favours more vegetable food than the animal food Planktonic algae are its main food in younger stages upto 20mm of which diatoms take the conspicuous position

2 From 21mm stage the fry starts taking animal food regularly Indeed, the carnivorous tendency develops in the fish from 15mm stage where it takes a little amount of protozoa The piscivorous tendency develops in it from 35mm stage and the gradual increase in the percentage of fish scale in the stomach contents of the successive stages indicates its cannibalistic nature

3 Presence of very little percentage of crustacea in the stomach contents of the stages from 45mm onwards and the absence of any remarkable amount in the diet of the earlier stages show that the fish has very little liking for crustacea

4 Presence of the appendages of shrimp and the fish scales and the absence of any entire animal

in the stomach of the fish suggest that the fish is not very well provided with the mouth parts suitable for taking slightly bigger animal food But the urge for animal food makes it to peck and tear off a portion from the body of the bigger animals The morphology of the mouth parts also supports this view Additional support can be had from Inns[9] who stated "Like many brackish water and marine fishes, it moves energetically about the aquarium chasing its fellow and other fishes, but it is one of the chasers which does little damage "

5 Presence of remains of sponges, muds and sands and inorganic debris in the stomach of almost all the stages suggests its bottom feeding nature

6 The study of the food and feeding habits supports the statement "As a matter of fact they (*Scatophagus argus*)are something of gluttons" (Inns[9])

It is remarkable to state that the fish is very adaptable to freshwater Some fry of this fish were brought from their natural abode to the laboratory and transferred to the aquaria containing freshwater of a local pond It is needless to state that when supplied with proper food and regular change of water they have shown normal and healthy growth We have further detected the presence of this fish in large numbers in many fresh water ponds near the river Rupnarayan in healthy and normal condition

As this fish is found in abundance in the lower portion of the tidal rivers and in saltwater *bherıs* (turns) in connection with the estuaries, emphasis should be given to the extensive culture of this fish in the ponds and other enclosed waters of the Lower Bengal Culture of this fish is profitable owing to the following reasons

1 Fry are available in all the estuaries and can be collected with minimum cost

2 Food of both the fry and adult stages is easily obtainable as the organisms found in the diet are generally found in all the freshwaters of Lower Bengal Whenever absent they may be cultured easily

3 Partial saline water, which are unsuitable for carp culture, can be secured for the culturing of this fish at a cheaper rate

4 The fish attains a fair size within a short period

5 There is a considerable demand for this fish in the market

H K Mookerjee
D N Ganguly
T C Mazumdar

Fishery Laboratory, Department of Zoology,
Calcutta University 22-6-1949

[1] Devanesan, D W *Journ Mad Univ*, *4*, 1942
[2] Ibid, *Curr Sci* *11*, 142, 1942
[3] Hornell, J , and Nayudu, Ramaswami M , *Mad Fish Bull* , *17*, 1923
[4] Job, T J , *Rec Ind Mus* , *42*, 2, 1940
[5] John, C C and Menon M A S , *Curr Sci* *12*, 243 44, 1942
[6] Southwell, T *Ceylon Adminstr Rept* IV , *Education, Science & Arts, Marine Biology*, 1913
[7] Mookerjee, H K Ganguly, D N and Sircar, Ajit, *Proc* 33rd *Ind Sci Cong Asoc* III, 132, 1946
[8] Mookerjee, H K Ganguly, D N and Mazumdar, T C , *Science and Culture*, *11* 10, 1946
[9] Mookerjee, H K , Ganguly D N and Pakrasi, B , *Science and culture*, *13*, 162 63, 1947
[10] Inns, T W , *The Aquarium* *17*, 10, 1948.
[11] Pearse A S *Bull U S Bur Fish*, 23, 1916
[12] Breder, C M and Crawford D R , *Zoologica*, *3*, 14, 1922

THE EFFECT OF HAIL STORM ON THREE CROP PESTS

Spencer[1] in British Columbia observed the effect of hail storms on grasshoppers

On May 7, 1949, in Bodhan (Deccan) there occurred a very severe hail storm which did damage to the standing sugarcane and paddy crops Opportunity was taken to observe the effect of this hailstorm on two paddy insect pests—the third brood adults of *Hispa* (*Hispa armigera* ol) and the early instar nymphs of small paddy grasshopper (*Oxya velox*) which were observed in numbers on the standing paddy crop two days previously Extensive observations revealed that the hail storm had done absolutely little or no damage to either of these insect pests

Observations on the effect of hail storm, on the other hand, on sugarcane leaf mite (*Paratetranychus indicus* H) showed that neither the adult nor egg stages of the pest which were visible in their peak stage two days before were observed now

D V Murthy
A S Rao
Md Qadiruddin Khan

Sugarcane Entomological Laboratory,
Department of Agriculture,
Bodhan (Deccan) 9 6 1949

---

[1] Spencer G J , *Canadian Ent* *72* (12), 233-234, 1940

DATURA METEL AGAIN

Narayanaswami's recent reply[2] to my letter has taken the point very much astray It was made abundantly clear in my letter, that the findings of Narayanaswami (1948) were exactly the same as that of Safford (1921 and 1922), and therefore no additional information was available from Narayanaswami's letter Besides, if the sole object of the note was to make a new variety *i.e.*, *Datura metel* var *fastuosa*, this has also unfortunately failed, as the combination was already made by Safford (1922) If Safford's papers were acknowledged by Narayanaswami either in his original note or in his reply, this correspondence would not have been necessary It is true that Safford did not have the opportunity of wandering in the *Datura* fields of India, but there is no doubt that he had examined a number of Indian herbarium specimens Narayanaswami has, it is assumed, studied the species wild in the field and his conclusions however are much the same as those of Safford

Narayanaswami has suggested that there are noticeable morphological differences in variation in the spiny covering on the fruits of some forms of *Datura* There is also a suggestion that other variations are induced due to climatic and edaphic factors In view of a number of intermediates, these variations cannot be regarded as of such stable characters as to warrant a varietal rank, but in fact, they belong to much lower categories of forms or races In his original note, Narayanaswami has rightly admitted that these characters are not enough for "varietal separation" So far as the forms or races of *Datura metel* are concerned, it has been stated that "the correct position regarding the several *forms* of this most protean species of *Datura*, particularly with reference to the variations under different climatic and edaphic conditions needs clarification" He seem to have overlooked Bergner's[3] paper on *Datura metel* This deals with an effort to assess the various morphological and cytological variations in a world wide collection of *Datura metel* From this intensive study in collecting, growing, and *inter se* crossing of forms of *Datura metel*, Bergner classified the whole collection into 61 races, which was further grouped into five chromosomal types Of these, the four types occurring in South East Asia differ from the Western Hemisphere type with reference to a single interchange between two non homologous chromosomes The flower colour, or the type of corolla, could not be linked with these chromosomal types Thus both taxonomically as well as cytogenetically the variations noticeable in *Datura metel* are to be regarded as insufficient to warrant a varietal rank for *Datura fastuosa*, and Safford was originally justified in reducing *Datura fastuosa* to a synonym of *Datura metel* (although later, and only once, he considered this to be a variety of *Datura metel*)

Finally I would yield to no one in my admiration of Haines' work on the *Botany of Bihar and Orissa* and Gamble's *Flora of Madras* There are however instances in these works where a few plant names are not in conformity with the nomenclatural rules or recent taxonomic revisions Such names are to be judged strictly on their own merits, and it does not matter in the least, whether such and such name has been used by Haines or Gamble In *Kew Bulletin* 1939 293, Airy Shaw has pointed out a case of wrong adoption of a name from Haines' work, and in my recent note on *Herpestis*[4] I have pointed out another instance from Gambles' work About the reference to Kanjilal and Das' *Flora of Assam*, Vol 3, I may say that in the acknowledged list of names of botanists who helped the authors of this work in various ways, Narayanaswami's name precedes that of mine

D CHATTERJEE

Division of Botany,
Indian Agricultural Research Institute,
New Delhi, 28-6 1949

[1] SCIENCE AND CULTURE *14*, 38 1948

[2] SCIENCE AND CULTURE, *14* 206, 1948

[3] *Am. Journ Bot 30* 222, 1943

[4] SCIENCE AND CULTURE, *14*, 156 1948

[This correspondence is closed Ed *Sci* & *Cul*]

A PRELIMINARY NOTE ON THE USE OF THE MALE TOAD *BUFO MELANOSTICTUS* SCHNEID., AS A TEST ANIMAL FOR BOVINE PREGNANCY

The publication of a recent book by Cowie[2] has now provided us with a comprehensive critical review of literature on bovine pregnancy diagnosis tests based on hormonal investigations of such body fluids as urine, blood saliva and milk Summarizing the literature he concludes (p 179) 'The diagnosis of pregnancy is generally possible in the cow from the third month of gestation by clinical examination *As yet no laboratory test, hormonal or otherwise, has been found of any value* in the early diagnosis of bovine pregnancy ' (Italics our own)

Since the suitability of male Salientia as test animals has recently stimulated a brisk investigation of pregnancy test in human medicine, especially for its very encouraging results in regard to speed of reaction, accuracy, sensitiveness and economy[1 5], it is thought worthwhile to apply the test to the cow Experiments similar to those carried out for human pregnancy test[1] were conducted in this laboratory Specimens of untreated first morning (overnight) urine from the pregnant cows (of 2, 4 and 9 months gestation) were injected, as usual, into adult male toads (*Bufo melanostictus*) In none of the test animals a positive response could be evoked even by using triple doses of 5 cc each at intervals of one hour This might well be due to a very low level of gonadotrophic hormonal contents or their total absence in the urine Our negative findings thus confirm those of previous workers (*vide* Cowie, 1948, pp 58 61) who used other test animals chiefly of the opposite sex Attention may be drawn here to a statement made by Cowie (1948, p 43) under the sub heading "*Male Bufo*" "The serum and urine of the pregnant mare, cow, sheep, and sow are said to give negative results" We are not aware of any bovine pregnancy urine test, using male toads

After the initial failure with bovine pregnancy urine as test material, we have used with success, (*as suggested by the senior author*) cow manure (cow dung) as a suitable material for diagnosing pregnancy in cows.

Technique The urine-free cow manure as supplied by the Bengal Veterinary College, Belgachia, Calcutta was used in this study After a few initial failure with different quantities (50 and 25 gms) in an attempt to find out an effective dosage level, it was observed that 15 gms of manure in 100cc of distilled water could be used as a suitable material for this test

Fifteen grammes of manure are stirred in 100cc of distilled water, and after straining this solution, it is centrifuged for an hour The decanted solution is finally strained through a fine filter paper (No 1) Special care should be taken to prepare this solution as clear as possible, otherwise it may be retained in the subcutaneous lymph spaces without being absorbed, and this may prove lethal to the test animal either during or the day following the experiment It should, therefore, be borne in mind that the more clear the solution, the quicker is the rate of absorption The chances of death of the experimented animals can thus be easily overcome or greatly minimised

So far as our preliminary investigation is concerned we used *Bufo melanostictus*, a common toad in India and the Far East, as the best suitable test animal In each test, before an injection is given, the toad should be checked by sampling its urine for examination under the microscope It must be negative, as is usually the case, and, thus, each toad becomes its own check

When the solution of manure is ready, a 5 cc dose is gently injected into a subcutaneous lymph sac of the toad to allow the material diffuse slowly It is then placed in a separate well ventilated container and set aside for half an hour at room temperature [It averaged 95 5°F (35 2°C) during the series of tests performed] At the end of this period it is made to reflexively eject a jet of urine in a separate receptacle, and this it readily does A drop of this urine is examined microscopically If spermatozoa are not found another half an hour is allowed to elapse for the re sampling of urine for the next examination If the result is negative, after an hour from the first injection, a second dose of 5cc of the material is forthwith administered In this way we injected to the extent of 4 consecutive doses of 5cc each at intervals of one hour till the end point of each test was clearly shown by the presence of spermatozoa in the toad's urine It may be mentioned here that the voidings of urine were regularly examined microscopically at intervals of half an hour for a total of 5 hrs in all The toad's spermatozoa are easily identifiable even under the low power microscopic examination When spermatozoa are present in any quantity, the test is positive, when they are not present, it is negative

Cow dung solution processed in the above way, or the cow dung itself, can be kept in a refrigerator for about a week without apparently any adverse effect Such material gave us the same satisfactory results as obtained in tests run on the day of receipt of fresh material This seems to indicate that the hormonal contents of the material do not deteriorate readily.

For control experiments, specimens of manure from 4 different non pregnant cows were similarly tested. But 5 consecutive doses, instead of 4, of 5cc each were injected into the toad at intervals of one hour, and the voidings of urine were systematically examined microscopically for 7 hrs No spermatozoa were encountered in the control series

The results of our preliminary investigation on a limited series of tests run during the months of April and May of this year are shown in the following table For each test 2 to 3 toads were used with a similar result

TABLE I

THE NUMBER OF DOSES AND TIME TAKEN FOR EVOKING A POSITIVE REACTION IN COWS OF DIFFERENT GESTATION PERIODS

Number of cows	Approximate gestation period (in days)	Injection schedule 1			2		3		4	
		observation in hours								
		0	½	1	1½	2	2½	3	3½	4
1	55	−	−		−	−	−	+	+	+
2	60	−	−	−	−	−	−	+	+	
3	65	−	−	−	−	−	−	+	+	+
4	86				−				+	+
5	90			−				−	+	
6	120					−	+	+	+	+
7	250		−	−		+	+	+		+
8	200				+	+	+	+	+	+

Nos 1—3 are artifically inseminated cows and their pregnancy confirmed afterwards

From the data in the accompanying Table, it may be appreciated that a small, though variable, number of doses is required to evoke a positive reaction Doses, ranging from 2 to 4, of the cow dung solution are required to reach the end point of the test Concomitant with the number of doses, the time factor operates for the release of spermatozoa in the voided urine The minimum number of doses and the time to reach the end effect are two and 1½ hrs, and the maximum, four and 3½ hrs respectively Neither a false negative, nor a false positive was ever obtained in any of the pregnant or non pregnant (control) cows

Now, the end point observed by us in the bovine pregnancy test is in a way comparable with that of the human pregnancy test, and this, by analogy, raises the question whether there may not be present gonadotrophic hormones in the cow manure It may pertinently be remarked here that Turner[6] in studying the effects of dried lactating cow manure in the ration of growing chickens, hints at the possibility of some gonadotrophic hormone activity in both cow and goat manures (especially slightly more in the latter), since there is apparent maintenance or slight stimulation of gonads in both cockerels and pullets The gonadotrophic hormone activity in the cow manure, as shown by the above experiments, seems, therefore, to be considerably interesting to bioassayists, Unfortunately we could not secure any specimen of cow manure earlier than 55 days' gestation The time and number of doses that might evoke a positive reaction in early pregnant cows would be of great interest, since the data given in Table 1 tend to indicate a poorly gametokinetic hormone activity in early pregnancy cases in comparison with that of late ones

The new test calls for further study The number of cases studied by us is too small to warrant definite conclusions Nevertheless, it certainly promises a good deal for future research It is hoped that the publication of this preliminary note may arouse interest in the study of this test, especially where artificial insemination is generally practised as a routine work

We take this opportunity to record our thanks to the authorities of the Bengal Veterinary College, Belgachia, Calcutta, for giving us specimens of urine and cow manure Our thanks are also due to Dr A B Kar, Calcutta for going through the manuscript and helping us with the kind loan of Turner s paper[6]

J L BHADURI
N R BARDHAN

Department of Zoology,
University College of Science and Technology
35 Ballygunge Circular Road,
Calcutta 19 30 6 1949

---

[1] Bhaduri J L and N R Bardhan *Science 109* 517 1949
[2] Cowie A T Pregnancy Diagnosis Tests A Review *Commonwealth Agric Bur Publ* No 13 Great Britain, 1948
[3] Galli Mainini, C *J, Amer Med Assoc 138* 121 1948
[4] Haines, M *Lancet* Dec 11 923 1948
[5] Miller, D F, and P B Wiltberger *Ohio J Sci, 38* 89, 1948
[6] Turner C W *Poultry Sci 26* (2) 143 1947

A NOTE ON STRATUS CLOUD OVER JODHPUR

Jodhpur (altitude 712 ft a s l) is located on the eastern edge of Thar desert The nearest distance from the sea is about 270 miles to the southwest The Aravali Range running NE to SW lies southeast of the station at a distance of about 70 miles

TABLE I

BASE OF THE STRATUS CLOUD

Months Years	No of Stratus hours	*Number of hours the base remained* 1000 to 1999 ft. a.g	600 to 999 ft a.g	300 to 599 ft a g	(a g above ground)
July 1945	84	50	29	5	
August, 1945	100	75	17	8	
July, 1946	75	73	2	0	
August, 1946	64	45	12	7	
Total	323	243	60	20	
		75%	18 5%	6 5%	

The low stratus cloud in the monsoon season comes as a surprise to many aviators who approach the station from Delhi, Lahore, Bombay or Karachi The base of the cloud is generally 700-1200 ft above ground and becomes hazardous to the aircrafts when the amount exceeds eight tenth On the days preceded by moderate to heavy precipitation, the stratus comes down to about 300 ft above ground and appears earlier than usual also Table I shows that 75 percent of total stratus hours the base was 1000 to 1999 ft above ground 18 5 percent 600 to 999 ft and 6 5 percent 300 to 599 ft above ground

Besides monsoon season (July and August), stratus has formed on a few occasions even in the month of May This stratus seems to be purely a result of turbulence The southwesterly winds were strong gusty (speed 20 30 mph or more) and the patches of stratus were justified on those days The base of stratus in this season was 1000 2000 ft above ground

The monsoon stratus is, however more persistent and very frequent in July and August The number of days stratus formed over the station during the two years 1945 and 1946 are given below

TABLE II

Months Years	Number of days on which stratus formed
July 1945	16
August 1945	14
July, 1946	12
August 1946	12

Table III, shows that greatest frequency is at about 08 to 1100 hours and after 1700 hours there is no stratus Unlike coastal stations (Karachi and others) Jodhpur has no stratus cloud in the evening and major portion of the night

The air in the lower layers (1 2,3000) over the station during July and August is SW Arabian current It is moist and generally overrun by a drier air from Baluchistan At the meeting place of these two currents and inside the moist air the stratus is formed by turbulence Why stratus immediately melts away after 1700 hours and doesnot persist throughout the evening or night as it does over Karachi and other similar places ? The reason is, that the excessive heat of Rajputana soon destroys the whole structure of the above air mass-arrangement through convectional currents and the stratus is thus no longer seen

The base of the stratus cloud can be forecast with the help of the local T—gram which gives a fairly reliable condensation level

TABLE [illegible]

Months Years	Total No of Stratus days	Number of times the Stratus formed at a particular hour															
		1800 to 0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700
July 1945	16	0	2	1	3	3	5	[illegible]	10	12	10	[illegible]	7	6	3	1	1
August 1945	19	0	1	1	3	4	7	8	13	12	10	11	[illegible]	9	6	2	2
July 1946	12	0	0	0	1	5	7	11	11	11	10	7	3	2	2	2	1
August 1946	[illegible]	0	0	0	0	3	6	10	12	11	10	5	2	[illegible]	2	1	1

In the end summary of low cloud formation over the station in different months has been added to complete the information on the subject

This note is based on the statistics of only two years but it readily gives an idea of frequency and base of stratus cloud over Jodhpur a place situated in almost a desert

NOTES 1 The base of the cloud has been taken from the station observations which were reported within the International limits but actually it was observed that the base of the cloud referred in this note was of the lower limit of the code *e g* code fig 4 (1000 1999) be taken as 1000 ft

2 Local time in the note is Indian Standard Time

SUMMARY OF LOW CLOUDS FOR JODHPUR

Jan Feb

No low clouds except under the influence of a western disturbance

Mar April

Sc Cu clouds base 2500 3500 ft above ground in the afternoon Large CU and Cunimb on some days mostly in the afternoon and evening

May June

Morning Stratus cloud base 1000 2000 ft above ground on a few days when strong gusty SW winds blow

Afternoon No low clouds on most of the the days Patches of Sc Cu may appear on some days, base 3500 4500 ft above ground

Night No low clouds

July August

Morning Stratus base 700-1200 ft above ground

Afternoon Sc Cu base 2-3000 ft. a g.

Night No low clouds except under the influence of monsoon depression, trough of low pressure or an active front

Sept October

Morning No low clouds

Afternoon Sc Cu when SW current in lower layers persists base 3500 ft a g

Nov December

No low clouds except under the influence of western disturbance

KHAN M SHAMSHAD

Pakistan Meteorological Department
Karachi, Pakistan 29 6 1949

DISEASE AND DISORDERS IN SOME INDIAN TOBACCOS

In a tropical country like India much inconvenience is felt by the cigarette manufacturers to avoid the infection from mouldiness of cigarettes Much work has been done abroad to study this phase of decay of tobacco True[1] is pioneer in this line His investigations revealed that Aspergillous conidias were universally present and appeared to be responsible for most of the spoilage His work however referred specially with cigars

Wollenweber[2] found that *Penicillium glaucum* Link and *Aspergillus glaucus* Link occur most commonly on cigarettes, stored in warm and damp situation Wolf[3] also has examined several commercial grades of flue cured tobacco for its microflora The results of these examinations show that the flue cured tobacco has a normal flora throughout, there is little seasonal variations in the kind and number of organisms present There is a tendency of all of the commercial grades to have the same kind of moulds such as *Aspergillus*, *Penicillium Cladosporium*, *Fusarium* and *Alternaria* Occasional samples yield *Actinomyces*

As the climatic conditions, etc , of our country are entirely different, this laboratory took up the work of investigating the common infection of the Indian tobacco and the cigarettes manufactured therefrom and as well as to find out some possible prevention for such infection. We are also trying to find out their relation, if any, with different soil conditions in India, In this connection we have taken up soil analysis, both chemical and bacteriological of different fields of tobacco growing area as well as analysis of different cigarettes manufactured from mixtures of foreign and Indian tobacco So far we have been able to isolate six species of fungi, three from tobacco and three from manufactured cigarettes They have been numbered as T_1, T_2, T_3 (from Indian tobacco) and C_1, C_2, C_3 (from cigarettes made of mixed tobacco) Their characteristics have been examined both microscopically and biochemically and they have been properly indentified

(1) C_1—*Penicillium*—very much alike *P glaucum*,
(2) C_2—*Aspergillus*,
(3) C_3 and T_1—*Aspergillus* Their formation of sterigmata, and ascospores with globular capsules give them resemblance with Aspnidulous
(4) T_2—It seems to have resemblance with *Rhizophorus oryzea* The organism spread by means of stolons
(5) T_3—This is a *fungus imperfecti* and is found to belong to *Oospora* (*Monilia*) genus

The spores of C_3 and T_1, were found to stand heating at 90°C for 5 minutes, whereas the spores of T_2 could stand 80°C

The moulds were found to grow at all events between *p*H 2 7 4, but more' vigorous growth was observed between *p*H 3-5

Effect of different sources of Nitrogen was also studied

The moulds are able to utilize a great many sources of carbon but most marked growth were observed with starch, glucose and sucrose

From the detailed study of these fungi it has been quite apparent that out of the six fungi isolated T_1 and C_3 belonged to the same species Other fungi isolated from Indian tobacco could not be traced out in the manufactured cigarettes but in their place we found two different species one is C_1, which is a *Penicillium*, other is C_2 which is an *Aspergillus*

In our opinion T_1 or C_3 is the contaminate of Indian tobacco and escapes destruction due to its high resistabilities when passed through different manufacturing processes The other two contaminate of cigarettes namely C_1 and C_2 are from imported tobacco They also survive the operations which corroborates the work of Wollenweber

Further work is in progress to correlate the growth of fungi with nature of soil from the tobacco growing area, unmanufactured tobacco and finished tobacco products We are also trying to find out whether there is any relation between growth of fungi and mineral deficiency of the soil

This laboratory has been able to find out a suitable agent which can very successfully destroy the spores of fungi without any effect on taste, aroma and quality of cigarettes Work in this line is in progress

Our sincere and grateful thanks are due to Mr B N Elias for the kind interest and to Mr S D Morris for his valuable advice and encouragement during the course of this investigation

G C Das Gupta

Research Laboratory,
National Tobacco Co of India Ltd ,
Agarpara, 24 Parganas
17 6 1949

---

[1] True R H , Bul U S Dept Agr No 169, p 8, 1914
[2] Wollenweber, H W , Mitt Gasell Worratsschutz , 4 (2), 21 23, 1928
[3] Wolf, F A , *Jour Agr Research*, 43, 165 175, 1931

BOOK REVIEWS

Mutiple-Beam Interferometry of Surfaces and Films—By S Tolansky Pp viii+187 Oxford University Press Price 18 s net

This book deals with the various methods of examining plane surfaces and films with the help of multiple-beam interference patterns formed by these surfaces under suitable conditions Starting with a brief account of the various types of Fizeau fringes formed by unsilvered surfaces in the first chapter the author has given a detailed discussion of the theory of formation of multiple beam Fizeau fringes in Chapter II In the next chapter the technique usually employed for silvering surfaces of glass plates and crystals has been described and Chapter IV deals with the nature of Newton's rings formed by silvered surfaces.

The methods of topographical studies of plane surfaces have been discussed in Chapter V and the next chapter deals with the methods of taking microphotographs of crossed Fizeau fringes formed by silvered surfaces This method is very interesting and the author's mode of presentation of the method with the help of beautiful illustrations is commendable His own contributions in this line of research are well known and the mode of presentation of those topics reveals his intimate knowledge of the subject

Chapter VII deals with the method of testing plane parallel thin sheets without the help of any auxiliary plane parallel silvered surface In chapter VIII the method of producing fringes of equal chromatic order has been described and in the next three chapters some applications of this method have been described Chapter XII deals with the mthods of examining surfaces of opaque substances with the help of reflection fringes formed by such surfaces in conjunction with auxiliary silvered plane surfaces and in the following chapter the method of making transparent plastic replicas of such surfaces has been discussed In Chapter XIV some suitable colour filters and monochromators used for the study of interference fringes are described and in the last chapter the theory of non localised multiple beam fringes has been given

Examination of plane surfaces is of course, necessary for making precision optical instruments but for certain fundamental investigations also such an examination of the surfaces of crystals may yield valuable results It is only in this particular book that all the sensitive methods for that purpose are compiled together and both the theoretical and practical aspects are discussed thoroughly The book will therefore be found to be interesting by a wide group of research workers Postgraduate students in physics will also find this book useful for getting clear ideas about formation of Fizeau fringes under different circumstances The price of the book seems to be moderate if the quality and the number of illustrations be taken into consideration

S C S

I S. I. Bulletin—Vol 1, No 1, January, 1949 Published by the Indian Standards Institution, Block II Old Secretariat, Delhi, 2 Annual Subscription is Rs 4/ (6s or $ 1 50) The Indian Standards Institution, which was founded in 1947 as a quasi Government Organisation, has published the first number of its quarterly journal, *I S I Bulletin*

The *Bulletin* contains the President's address to the General Council, messages from a number of Standards Institutions and Associations of other countries, much detailed information on its activities and also three interesting articles, *viz*, (i) Standard atmosphere for testing, (ii) Quality Control, and (iii) Weights and Measures The first article is a summary of the note on the subject "Standard atmosphere for India" which the Indian Delegation presented before the ISO Technical Committee on textiles (ISO/TC 38) at their first meeting held at Boston (England) in June, 1948 From a comparative study of data of temperature and relative humidity as obtained in the principal cities of India in different seasons of the year with those of other parts of the world, it was recommended that for tropical and sub tropical countries, such as India, the standard atmosphere should be defined as 80°F temperature and 65% relative humidity The recommendation was unanimously accepted so far as Textile Industry is concerned The second article is simply a record of activities made in other countries for quality control in the Textile Industry The third article contains a proposal for the adoption of the metric system with Indian names for the Units and a series of Indian prefixes and affixes to denote the successive powers, multiples and sub-multiples of ten has been suggested We, however, think that the terminology suggested is not in all cases very happy and practical, and more careful and scientific consideration is desired in this connection, specially as we have not as yet adopted any *lingua franca*

ISI has set up three Divisional Councils for Engineering, Textiles and Chemicals respectively, each having a number of Sectional Committees under it We would like to mention that in view of the importance of Instruments Industry in this country, an Instruments Industry Standards Committee should have a rightful place under the Engineering Division Council along the line of the British Standards Institution

P C M

Modern College Physics—By Harvey E White, Ph D, Professor of Physics, University of California Published by Messrs D Van Nostrand Company Inc, New York

This book removes a long felt want for a text book of physics for the basic training of students intending to specialise in any branch of life sciences Illustrations of physical principles are well chosen, not only from the field of engineering but also from that of biological and medical sciences to create and maintain interest of the beginners especially of the pre medical students in the subject

The book opens with an interesting and instructive chapter on optical illusions introducing the importance of the objective methods of measurements The less important portions of classical physics have been excluded The last quarter of the book is devoted to an introductory treatment of electronics as well as of atomic and nuclear physics because of their increasing application in every field of science All problems and mathematics are confined to elementary algebra, plane geometry and trigonometry Brief biographical sketches of the pioneers in physical science included in the foot-notes of the text are also its special features. The language of the book is very lucid and simple

The book is indeed suitable to be adopted as text book for the intermediate science course in physics of any Indian University but its high price may deny many of our beginners the priviledge of possessing a copy.

P C M

Ape and Essence—A Novel—By Aldous Huxley Chatto and Windus, London, 1949 7s 6d net

This highly imaginative book by Mr Huxley is a warning to mankind of what may happen if we continue our present day follies This cautionary tale which sounds more like a prophetic nightmare is in the form of an imaginary filmscript, discovered from a Hollywood dustbin, whose author has made full use of his imaginative genius to give a picture of California as it might be, in the year 2108, after a Third World War We see through the eyes of a member of New

Zealand Re Discovery Expedition to North America New Zealand survived and flourished in an isolation, while the rest of world suffered from the appalling legacy of atomic and bacteriological warfare, not for any humanitarian reason, but because it was too remote to be worthwhile to obliterate it from the map! Mr Huxley sees Progress and Nationalism as a Wedge which would not do Wedge's work 'without the width behind and as well as the edge in front" We at the moment present the Wedge in the wrong way The edge of the Wedge of our Progress and Nationalism is pressing towards man with all the scientific Evil at the width behind which has upset the equilibrium of Nature and is rushing upon the ruin of man who has sense of the principle of Good and worships Evil and is experiencing a moral disaster How far has our civilization progressed after Christ, who nineteen hundred and fortynine years back, was tried, convicted and tortured to death and not long ago an image of non violence, who got himself involved into sub human mass madness of nationalism which proved too much for him, was assassinated only because he wanted to convert what was satanic in the state to something like humanity Mr Huxley has tried to foresee through his imaginative genius what will happen if we persist in our present policies of greed and haste

H S P

Fluid Mechanics—By R C Binder, Ph D, Constable & Co Ltd, 10, Orange Street, London, W C 2 and Prentice Hall, Inc, N Y Cloth, 6"×9", pp ix+307, 1947 Price 30s

It is difficult to find a branch of pure or applied science which does not involve fluid mechanics Thus the flow of rivers and streams in their boundaries the percolation of water through the soil, motions in non stationary nebulae, the flight of a bullet, bird, insect or an aeroplane, the movement of a ship in the sea or of a fish in the depths of the ocean, the wind and the weather, lubrication of moving parts and the phenomena of heat transfer and sound, the denudation of soil and its conveyance to the sea, the circulation of fluid in pipes, the blood in our arteries, and veins, and more broadly the movement of nutrient and of scavenging media throughout the entire domain of organic life are nothing but expressions of the laws of fluid mechanics

With such a wide field, no text on fluid mechanics can ever be expected to cover the entire gamut on this subject and has necessarily to be restricted to some particular aspect only As pointed out by the author the aim of this book is to present an introduction to the fundamentals of fluid mechanics which is maintained by keeping the physical concepts and basic established quantitative relations in the foreground In this respect the work is akin to Professor Vennard's "Elementary Fluid Mechanics" (Wiley) but differs from Hunsaker & Rightmires 'Engineering Applications of Fluid Mechanics' (McGraw Hill), wherein the applications of its laws are dealt with in greater detail

The sequence of rigid body mechanics *viz* statics to kinematics and then to dynamics, forms the basic arrangement of the book The first half of the text gives an introduction to fluid properties, followed by particular cases of incompressible and compressible flow in and around pipes, including discussions on the dynamics of lift and propulsion, and fluid measuring instruments The latter part of the book is relegated to the practical applications in lubrication, reciprocating, centrifugal and propeller pumps, and turbines, fluid couplings, fluid torque converters and other control systems

To a student of applied mathematics, the last chapter on the mathematical study of fluid motion will be of interest Herein the author surveys the broad field of elementary hydrodynamics in a very lucid manner and shows that a mathematical analysis may be a valuable and even economical method for discovering and understanding certain conceptions and trends in fluid mechanics which are not apparent from a purely physical study Each chapter is followed by selected references for further study and interesting problems for solution

Originated by Archimedes from the principles of statics, the science of fluid mechanics has today developed to a very exacting and intricate subject Thus Euler developed the concept of ideal fluids which was notably extended by Helmholtz, Kirchoff, Kelvin, Lamb and Rayleigh This classical science of hydromechanics of the 19th century merged into the practical fluid mechanics of today by Prandtl's enunciation of the concept of boundary layer surrounded by an ideal continum, the circulation theory proposed by Lanchester and Kutta and developed by Joukowski & Prandtl, and the theory of dimensions advanced by Rayleigh Added to these, the contributions of the author in this text leave little to be desired for a clear understanding of the laws of elementary fluid mechanics

S K G

SCIENCE AND CULTURE

A Monthly Journal of Natural and Cultural Sciences

Vol. 15 SEPTEMBER 1949 No. 3

SECOND ANNIVERSARY OF INDEPENDENCE

ON AUGUST 15, India celebrated the second anniversary of her independence. People throughout the length and breadth of this vast sub continent remembered with pride and glory the achievement on this day two years ago of political freedom for which generations of men and women toiled, fought and courted untold sufferings including death. The whole country paid tribute to the memory of those valiant fighters of freedom who fell in harness so that posterity may live better.

The attainment of a country's political freedom is a great thing. But it is not an end in itself. Political freedom is after all a means and a condition of realizing higher human values based on peace and prosperity. It is really a powerful instrument with which to attain other and more fundamental freedoms which we are yet far from attaining. Millions of men and women of our country are still slaves to the tyranny of hunger and preventible diseases powerless against their daily problems of life for ignorance and lack of education, for unemployment and hundred other social and economic evils. People who are unable to meet the basic needs of life such as adequate food shelter and medical care and find it difficult to avail themselves of certain educational, cultural and recreational opportunities are, to our mind, in perpetual bondage and slavery no matter whether they enjoy political freedom or not.

It is for this reason that to a vast multitude of people, political freedom must remain of little or no significance, perhaps hardly anything more than a mere emotional satisfaction, as long as there is no visible and demonstrable sign of this freedom being utilized for the economic, social and cultural development of these vast multitudes. If we look into the contemporary history of politically free but backward and underdeveloped areas of the world to day, such as, the Middle East, China, the small states of Latin America, we shall find that a deep sense of frustration and helplessness is widespread there. Such kind of frustration is bound to happen in our country also if we fail to properly utilize our hard earned political freedom.

The Prime Minister Pandit Nehru, hoisting the national flag on the historic Red Fort said Our task is to consolidate the freedom that has been won through the sweat and toil of millions of our countrymen. Nothing is in fact, more important and urgent than this. But the question is how speedily and quickly can this consolidation be effected and by what means. Orthodox politicians—and they are still the most powerful groups in deciding the destiny of the country—believe that the consolidation of our freedom can be achieved primarily by political means. Political stability is no doubt an important condition, but as we have often stressed in the columns of this journal, freedom can only be stabilized by strengthening our economic front. India's chronic poverty arising from her economic backwardness is our real national problem. A poor country with undeveloped resources is always a play ground of foreign power politics, a standing invitation to economic or political aggression whenever there is a favourable condition for it, and a fertile ground for continuous internal troubles. Unless we can take a bold step towards liquidating poverty, our effort to consolidate freedom by any other means is doomed to failure.

The liquidation of poverty cannot be achieved overnight. The vast resources of the country, namely, the agricultural, mineral and power resources which are lying mostly undeveloped, are the only source of our wealth with which to improve our national standard of living. Our formidable labour force and man power and our intellectual and technical ability are the only asset. This, in the last analysis, is more or less the problem confronting the under developed countries of the world today. It was primarily in recognition of this fundamental fact that the United

Nations Organization welcomed President Trumans Fourth Point advocating a technical aid programme for the economic development of the backward countries

True we have to depend on more developed countries for the supply of capital goods but we have to obtain them by voluntarily accepting all possible austerity measures and temporarily denying ourselves all avoidable luxuries The resources of a country with its economy primarily based on agriculture are always insufficient for the purchase of capital goods in adequate quantities from abroad It is particularly acute in the case of India which does not again produce enough food Therefore the normal process of industrializing the country by obtaining foreign capital goods in exchange of our agricultural produce and some minerals which we mine but which we have not the means to utilize needs must be a slow one unless as the Soviets did we propose to go hungry and save whatever we can for securing essential machines Even this will be a hard and difficult task Organized foreign interests would always try as they are doing now to prevent the supply of capital goods namely heavy machines and plants to India and encourage the sale of manufactured articles In this discouraging set up only a well thought out plan of all round resource development and the determination of the Government to carry it out as a first national priority to the best of their resources can assure the people of better shape of things to come and create an atmosphere of hope of more work and productiveness, which we must confess is sadly lacking in India to day

On the contrary there is a tendency to encourage grandiose plans for modernizing the defence forces of strengthening the navy of developing first class civil aviation in India and of embarking on such unproductive undertakings because they are popular elsewhere and readily appeal to the imagination of common people here We do not minimize their importance But in a country where transport by road and rail is bad mileage hopelessly inadequate villages are in ruins towns and cities crowded beyond all proportions and lacking in elementary sanitary provisions and where there is a shortage of consumer goods of all descriptions such plans will ultimately fail to arouse widespread conviction and enthusiasm Such unplanned and uncoordinated expenditure has resulted in a shortage of capital already scarce to finance important and essential development projects such as the multipurpose river valley development projects whose progress has consequently been discouragingly slow and halting

At the beginning of the third year of our independence, it is of special importance to recall the role of scientists and technicians in national development It is no exaggeration to say that in the long struggle for independence, the scientists along with other educational and cultural groups played a part of which they might well be proud Our freedom movement was preceded, as is well known to all, by an intellectual renaissance towards the end of the last century By their researches and investigations which were not infrequently of a standard attained in the more advanced countries the scientists enhanced this renaissance and raised the intellectual prestige of the Indian people The work of the scientists led to the development of a new creative spirit which in a large measure, formed the basis of our nationhood In fact nationalistic considerations were an important factor in the establishment of the Indian Institute of Science the University College of Science and Technology the Indian Association for the Cultivation of Science of the science departments of the Universities and of scores of scientific societies associations and academies In their several speeches and writings the early pioneers of scientific education and research Dr Mahendra Lal Sircar Dr Rajendralal Mitra Sir Asutosh Mookherjee Sir P C Ray never failed to emphasize the importance of science in national affairs and of its applications to the arts of life Even during the latter half of the nineteenth century there was a reasonable recognition of the vital role science was destined to play in the life of the common man and hence of the nation In April 1871 *The Indian Daily News* now defunct wrote as follows in connection with Dr Mahendra Lal Sircars scheme for establishing a Science Association

> No one can now a days deny the special influences of certain sciences upon the social condition of a country The neglect of the physical sciences in the history of any people may easily be shown to have retarded more than any other circumstance their social and material progress Mr Justice Phear has often pointed this out to the Bethune Society and advocated the study of the Natural Sciences more than the study of Mental or Speculative philosophy which extends over a large part of the field of Hindu literature It is one of the peculiarities of that literature that while it exhibits a high capacity for metaphysical and abstruse pursuits it shows a lamentable want of progress in science generally and in the aesthetic arts One of the consequences is that nowhere in the history of the people has the aid of Science been brought to bear on industrial pursuits and the material welfare of the community has been thus apparently neglected

Looking into the future our scientists and technologists will be indispensable at every step of our economic and material development No plan of development whether in respect of modernizing agriculture and producing more food of establishing new industries of developing hitherto undeveloped resources of improving transport or of irradicating preventible diseases and so on can be carried out without the help of thousands of scientists engineers agricultural specialists medical men and technicians of all descriptions In fact adequate supply of these trained people might well be a serious bottleneck in implementing development plans in the very near future for which disturbing signs are already visible Difficulties have been reported in finding suitable scientists and technicians for the few research institutes and national laboratories and for the river valley development schemes Many universities have been depleted of their first class research workers to meet their modest demand for scientists, and crisis in teaching and research in the universities is slowly developing, which is likely to assume serious proportions before long

The country has stepped into the third year of her independence There have been many failures as well as many notable successes A newly born nation will be judged not so much by these failures and successes as by the general direction of her policy and by the bold approach to solve some of her basic problems Have we yet taken this bold step to grapple with our fundamental problems in a planned and coordinated manner?

ORGANIZATION OF SCIENTIFIC RESEARCH IN FRANCE

S N SEN

[*Continued from the previous issue*]

IV ACHIEVEMENTS OF THE CNRS

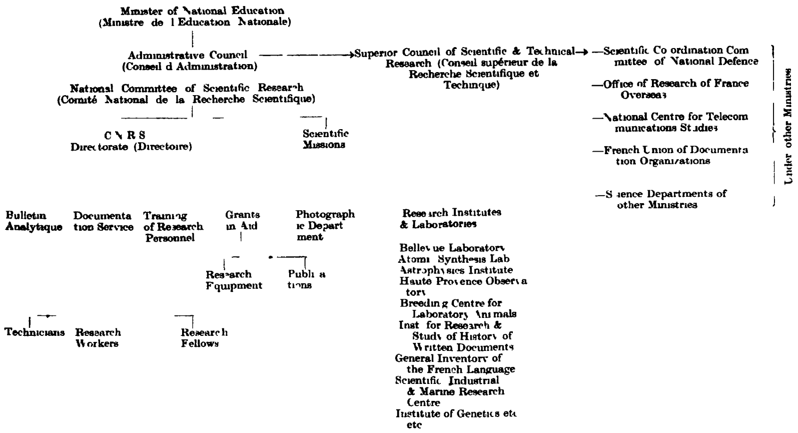
The growing importance of the Centre can be best judged by considering some of the results it has been able to achieve during its brief existence At present its principal efforts and activities concern the recruitment and training of an adequate number of research personnel and laboratory technicians the provision of grants in aid for the purchase of scientific equipment and for scientific publications and the development and maintenance of a network of research institutes laboratories and centres Besides the Centre has established a Documentary Service a Photographic Department and a Journal *Bulletin Analytique* It has also organized a number of scientific missions to foreign countries These activities will be briefly noted in this section and a separate section is proposed to be devoted to the various institutes and laboratories under the Centre The organization of the centre is shown in the chart on next page

Recruitment and training of research workers The recruitment of research workers is the main task before the CNRS Since the Liberation the Centre has shown the maximum possible generosity in awarding fellowships and grants to prospective scientific workers with a view to the fullest possible development and utilization of potential talent A sponsorship system introducing different categories of research workers was instituted which enabled a substantial increase in the vital research personnel

The first and by far the most important measure under this sponsorship system was the equalization of the status of research workers with that of teachers in the field of higher education by putting a Research Assistant on the same footing as regards salary as an Assistant Lecturer a worker in charge of research on the same footing as an instructor a Research Supervisor as a Lecturer and a Research Director as a Professor There can indeed be no question said Dr Teissier the Director of CNRS of treating a man carrying out research, while at the same time giving instruction, less favourably than a man who is merely carrying out his own research work—on the assumption of course that the people concerned are of equal competence Admittedly the salaries at present paid to research workers are quite inadequate but they are no more or less so than those paid to members of university staff Improvement in their position is possible only concurrently with a comparable improvement in that of the teaching staff

A second very important measure was that by which an education official or indeed an official of some other public service could be seconded for research work whilst preserving his salary and opportunities for promotion in his own department This measure ensured a flow of recruits of high standard It also proved advantageous to higher education particularly in the field of the social sciences as it enabled secondary school teachers to spend the two years necessary to complete their thesis which was often indefinitely postponed because their financial situation made it impossible for them to take the requisite leave In applying this measure opposition was encountered from the secondary schools which were already suffering from an acute shortage of staff but this opposition has now faded away on account of the inherent merits of this provision

The CNRS has encouraged another interesting provision which has been in existence since the foundation of the Caisse des Sciences It is the provision for the award of grants to supplement the salary of an official who owing to the absence of a vacancy, is not promoted as quickly as he seems to deserve Although it is excellent in theory and often good in practice this provision sometimes causes difficulties, particularly in the broader interpretation which has recently been given to it a departmental head who is anxious to be fair finds it a source of countless problems and the dissatisfied find in it many causes for complaint It is nonetheless true that it is a humane measure which does undoubtedly stimulate research and should be maintained provided that its operation is properly supervised


Minister of National Education
(Ministre de l Education Nationale)
Administrative Council
(Conseil d Administration)
Superior Council of Scientific & Technical Research (Conseil supérieur de la Recherche Scientifique et Technique)
—Scientific Co ordination Committee of National Defence
—Office of Research of France Overseas
—National Centre for Telecommunications Studies
—French Union of Documentation Organizations
—Science Departments of other Ministries
Under other Ministries
National Committee of Scientific Research
(Comité National de la Recherche Scientifique)
C N R S
Directorate (Directoire)
Scientific Missions
Bulletin Analytique
Documentation Service
Training of Research Personnel
Grants in Aid
Photographic Department
Research Institutes & Laboratories
Bellevue Laboratory
Atomic Synthesis Lab
Astrophysics Institute
Haute Provence Observatory
Breeding Centre for Laboratory Animals
Inst for Research & Study of History of Written Documents
General Inventory of the French Language
Scientific Industrial & Marine Research Centre
Institute of Genetics etc
etc
Research Equipment
Publications
Technicians
Research Workers
Research Fellows

ORGANIZATION OF CNRS

As a result of the application of these measures, the number of research workers has increased from 600 in 1944 to 1,000 in 1945 and 1,300 in 1946, thus more than doubling in two years. This number still falls far short of the growing requirements. Although the requirements of scientific staff cannot be precisely estimated, it is perhaps correct to say that to solve adequately the problem of supply of scientific personnel the present number would have to be doubled during the next five years or so. This seems to be the target of the CNRS, according to its present plan.

It is not sufficient, however, merely to increase the number of workers; it is also essential to develop in new entrants to the profession the special technical knowledge necessary for research. This question is intimately connected with that of the reform of higher education, to which the government have given serious consideration during the past few years. Independently of any such reform the Centre has already provided some preparatory training for research consisting of a series of technical courses given by professors and research workers. Under this system the latter will be obliged to undertake new duties and in particular to share the experience gained in their own research with their younger colleagues and to devote part of their time to work of joint interest to them and their juniors. For this purpose regulations have been prepared with the assistance of the Association of University Teachers and Research Workers which are expected to come into force in the near future.

Furthermore, the CNRS has strongly felt that although it is certainly not desirable that research workers should be treated as ordinary officials, it is necessary that those who spend their whole career in research should be provided with some security for the future. For this purpose the Centre has proposed a pension scheme for the research workers.

Technical Assistants. The CNRS has also devoted considerable attention to the question of technical assistants or lab boys. All scientific work involves a large measure of drudgery work which can well be handed over to an assistant without scientific qualifications. The industrial laboratories had long been employing technical assistants with great success, but the attempt to introduce such assistants to help fundamental research was new and it soon produced encouraging results. In the course of two years from 1944 to 1946, the CNRS has to increase the number of techical assistants from 450 to 700 in order to meet a growing demand for such service.

The status of the technical assistants has also been revised. Up till 1945, the technical assistants all received about the same salary, which was invariably small. By a Decree of August 1945 they were divided into four classes corresponding to a similar number of classes prescribed in the regulations governing the payment of staff employed in industrial establishments. These four classes are as follows: technical worker, corresponding to a "workman", technical assistant, corresponding to a "technician", associate technician, corresponding to a "foreman" and head technician, corresponding to an "engineer". This provision made it possible to revise their salaries and to make their payment dependent upon the type of work performed. It has also had a paradoxical result as a technician may now earn considerably more than the scientist he assists—a further proof of the disquieting disparity between official salaries and industrial wages. It seems hardly necessary to emphasize the danger to research to which this situation would give rise if it were unfortunately to continue.

Of all the services under the control of the Ministry of Education, the CNRS is practically the only one which is able to employ technical assistants. Consequently certain other branches such as museums and libraries when they were short of the necessary staff, asked for —and were often given—technical assistants.

Grants in Aid for research equipment and publications. This is another important feature of the CNRS activities. A considerable portion of the budget is earmarked as grants in aid for the purchase of research equipment. In 1946 CNRS spent about 53 million francs which was more than five times its expenditure over this item during 1944. But on account of a steady and steep rise in prices this hardly represented any gain in terms of material equipment and the need for more and up to date research tools in most laboratories remains as pressing as it was four years ago. The Centre is aware of this position and tries hard to provide as much as it can. Recently it started to prepare an inventory of equipment purchased with CNRS funds with a view to effecting the greatest and at the same time the most economic use of the existing equipment.

Provision for financial aid to the publication of research papers is an old and well established policy. Grants are made to periodicals of recognized scientific value. Occasionally the Centre takes full responsibility for the cost of printing and publishing scientific papers which it considers will have a far reaching influence. Grants in aid are also made to help scientists publish their work themselves. In 1946 the Publications Grants of the Centre amounted to 22.5 million francs.

The CNRS Documentation Centre. The Documentation Centre of CNRS was organized in December 1939 following a plan prepared by Professor Pierre Auger to provide French science with copies of scientific articles appearing in foreign journals which would otherwise be unobtainable. Its service is playing an increasing role in the supply of scientific information to scientists in France and abroad. Some 5,000 scientific periodicals are received and stored by the library of the Centre at 45 rue d'Ulm. Short indicative abstracts of the articles in those periodicals are published monthly in the "Bulletin Analytique" which appears in two sections.

An essential part of the Centre is its microfilm service which will supply a microfilm or full size copy of any article abstracted in the Bulletin Analytique , or of any article which may be obtained in the libraries of Paris

The Centre acts as a depository for these and scientific papers which would otherwise not be published It publishes an abstract of these papers in the Bulletin Analytique and supplies microfilm copies on request

V RESEARCH INSTITUTES LABORATORIES AND CENTRES UNDER THE CNRS

The CNRS maintains and finances a number of scientific institutes laboratories and research centres all over the country Those laboratories and research centres largely supplement the research work already being carried out by the University of Paris and its affiliated institutes the provincial universities and the special research institutes like the Collège de france the Museum National d Histoire Naturelle the Paris Observatory Institut du Cancer etc

Following is a list of the important laboratories and centres under the direct control of the CNRS

BELLEVUE LABORATORY (LABORATOIRE DE BELLEVUE)

The Bellevue Laboratory developed under the former establishment of the Office National des Recherches Scientifiques et Industrielles et des Inventions of which mention has been made It consists of a group of laboratories and is principally concerned with applied science The Laboratory is directed by M Gondet with M Quevron as the assistant director Although the laboratory is principally carrying out its own research programme it undertakes research on particular subjects requested by organizations outside the CNRS The main buildings of the Laboratory are located at 1 Place Aristide Briand Belevue (Seine et Oise) and house the administrative departments reading room library inspectors office scientific apparatus and storeroom and the following laboratories X ray high tension electricity nutritional biochemistry magnetism electro magnetics paint varnish tar fats rare soils photography films quartz and silica and heat

The Laboratory has another building at Meudon which houses the laboratories concerned with low temperature physics low temperature biology aeronautical research thermal exchanges and atmospheric thermo dynamics

The group of laboratories at Bellevue have grown greatly since the Liberation The mechanical work shop has been re equipped with a number of modern precision machines Many laboratories are at present being organized or built, either by the CNRS itself or as the result of agreements between the CNRS and other bodies for the prosecution of research according to a jointly prepared plan Examples are the Chevreul Fats Laboratory, in association with the technical Institute of the Office Professionnel des Industries des Matières Grasses the Paint and Varnish Laboratory, in association with the ' Office Professionnel des Peintures et Vernis the Low Temperature Laboratories dealing either with problems of icing (in association with the Office National d Etudes et de Recherches Aéronautiques) or with industrial applications (low temperature drying of organic substances *e g* blood plasma) the Laboratory containing the large permanent magnet and the X ray Laboratory

ATOMIC SYNTHESIS LABORATORY (LABORATOIRE DE SYNTHESE ATOMIQUE)

This laboratory (67 rue Franklin Ivry Seine) was established by the Compagnie Générale Electrocéramique It was originally known as the Ampère Laboratôry and was used for testing high tension apparatus In 1937 the CNRS assumed control of the laboratory and further extended its scope by installing departments of biochemical research Its main work is the study of artificial radioactivity

The building includes a large hall in which electric generators of very high voltage are installed and chemical and biological laboratories Directed by Professor Joliot Curie the laboratory has the following research personnel M Swingue Mme Moreau M Saumeria Nahmias Duchon Hubut and Bachet

Astrophysics Institute (Institut d Astrophysique)

In 1936 the Service Central de la Recherche Scientifique the predecessor of the CNRS set up the Institut d Astrophysique (98bis Boulevard Arago Paris) which together with the Observatoire de Haute Provence established at the same time constitutes the present Astrophysics Department of CNRS

The building consists of two storeys with a central block and two wings There is a coupola above the central block which houses the administrative departments the calculation offices the stellar statistics department and a lecture hall One wing houses the laboratories and the other the optical mechanical and carpentry workers rooms The scientific divisions include statistics optical measurements micro photography theoretical physics and a technical division Since the beginning of 1937 the Institute has provided for the training for research in astrophysics and has organized a series of technical lectures to that effect

The Institute directed by Dr Chalonge has the following research staff Guintini Mayot Barbier Schatzmann Kourganoff Fauvet and Laffineur

HAUTE PROVENCE OBSERVATORY (OBSERVATOIRE DE HAUTE PROVENCE)

Before the war the CNRS undertook to build this now observatory at Saint Michel near Forcalquier, in the Basses Alpes The work on it was delayed by the war and is not yet finished The observatory is equipped with a large telescope of 1m 20 diameter a Chalonge microphotometer and a photographic laboratory Mechanical and carpentry workshops are attached to it Several observation domes have already been installed and are in use Dr Dufay is the director of the observatory

Breeding Centre for Laboratory Animals (Centre d'Elevage des Animaux de Laboratoire)

This centre (49 Avenue Saint Maurice Paris) was set up in 1940 to breed experimental animals and supply laboratories which were finding it difficult to obtain animals during the war The animals are bred at the Zoological Gardens in the Bois de Vincennes the Ménagerie at the Jardin des Plantes the experimental station at Richelieu (Ille et Vilaine) the Neyer estate and at Bormes les Mimosas (Var) The most important centre is that at Vincennes where the administrative departments are also located The centre is directed by M Urbain

Institute for Research and Study of the History of Written Documents (Institut de Recherche et d'Histoire des Textes)

This institute (87 rue Vieille du Temple Paris) which was founded by Felix Grat in 1937 under the auspices of the CNRS was removed to Laval at the beginning of the war When it returned to Paris in September 1940 the Direction des Archives de France gave it accommodation in premises attached to the Hotel de Rohan Miss Vieillard is the present director

The purpose of the Research Institute which includes a photographic laboratory is to study the written heritage of human thought from the ancient documents and scripts (Greek and Latin) and from those of the Middle Ages (in Latin Greek Arabic French and Provençal) Such manuscript documents are microfilmed for use in French and foreign libraries and enlargements and indexes of such microfilms have been made available for scholars

Another section attached to the Institute carries out research on French mediæval cartularies and a great number of archival documents

General Inventory of the French Language (Inventaire General de la Langue Francaise)

Originally set up in 1936 as an independent organization and later brought under the control of the CNRS this body (33 Quai de la Tournelle Paris) proposes to make an inventory of French vocabulary from literary sources of all periods of history The vocabulary of the language spoken at the present time is being recorded Words with the sentences in which they are found are catalogued on cards under the name of the author or document using them They will afterwards be assembled in one worldlist which will be constantly kept up to date The task of abstracting the vocabulary is carried out by qualified assistants and revised by scholars with special ability for the work M Mairo Roques is the director

Scientific Industrial and Marine Research Centre at Marseilles (Centre de Recherches Scientifiques Industrielles et Maritimes de Marseilles)

This centre (66 rue Saint Sébastien Marseilles) was established in 1941 with the staff from the Centre d'Etude de la Marine Nationale later on increased by other research workers At the present time it acts as a branch of the CNRS and includes laboratories concerned with psychotechnology acoustics ultra sonics chemistry optics x rays motors corrosion etc Occasionally the centre admits a few students who wish to prepare a thesis on the special subjects studied at the centre or to carry out experiments and research work for other bodies M Canac is the present director

The outbreak of hostilities and the occupation severely affected the activities of the CNRS which had to concentrate all its resources on war efforts and later on to the cause of the resistance movement After the Liberation the CNRS resumed its work with renewed vigour and proceeded with the task of filling the gaps in the existing research structure A large number of research laboratories and centres were planned and brought into existence of which the following is a list

Technical Photographic Centre
Technical Centre for the Chemical Analysis of Minerals and Rocks
Technical Centre for the X ray Analysis of Minerals (Director Wyart)
Technical Centre for the Analysis of Gases (at the Collège de France) (Director Lepape)
Technical Centre for Spectrographic Analysis
Technical Centre for the Manufacture of Thin Sheets and for Polishing
Laboratory for Chemical Treatment (15 rue Georges Urbain) (Director Chaudron)
Oceanographic and Marine Biological Centre (experimental station at Chateau de Longchamp Bois de Boulogne) (Director Paguad)
Hydrobiological Research Centre
Sahara Research Centre (Beni Abbes Algeria and Geological Laboratory of the Sorbonne) (Director Menchikoff)
Laboratory for Organic Micro Analysis (at the Ecole de Physique et de Chimie 10 rue Vauquelin Paris) (Director Kahane)
Scientific Anthropological Research Centre (41 rue Gay Lussac)
Sociological Research Centre (2 rue Montpensier Paris)
Institute of Genetics (13 rue Pierre Curie) (Director Ephrussi)
Department of Phyto geographical Maps (Faculty of Science, Toulouse) (Director Gaussen)

Laboratory of Nutritional Physiology (16 rue de l Estrapade Paris) (Director Mrs Randoies)

Electrostatics and Metallic Physics Laboratory (Institut Fourier Grenoble Isore) (Director Neel)

Research and Study Centre for Applied Organic Chemistry (12 rue Cuvier) (Director Gault)

Cosmic Rays Laboratory on the Aiguille du Midi (Director Leprince Ringuet)

Technical Centre for Preparatory Training for Research

Electrophoresis Centre

Blaise Pascal Institute of Calculation (combining M Perès electrical analogue laboratory and M Couffignal s mechanical calculation laboratory which was established in 1945 13 Quai d Orsay) (Director Perès)

Centre for Study of Thermic Energy of the Sea (8 rue Paul Baudry) (Director Nizery)

Micro palaeontological Centre

Experimental Morphology Centre

Centre for Cartographic Documentation (191 rue Saint Jacques) (Director Cholley)

Laboratory of Human Biometry (41 rue Gay Lussac) (Director Laugier)

Econometric Centre

Most of these research centres represent an extension of research facilities on special subjects in the existing institutes like the College de France the Ecole de Physique et de Chimie the Institut de Geographie etc But the list also includes entirely new research institutes with new buildings and laboratories Thus the Institute of Genetics and the National Centre for the Co ordination of Study and Research on Food and Nutrition will be set up in a new estate 64 hectares in area at Gif sur Yvette which the CNRS has recently purchased On this pleasant site far from the madding crowd it is planned to establish a new city for scientific research with the most modern equipment and facilities

VI SCIENTIFIC MISSIONS ABROAD

The United Kingdom During the war the French Government like many other Allied nations were active in organizing scientific missions abroad and in maintaining scientific liaison offices in foreign countries Bilateral arrangements for effective scientific co operation were specially agreed upon with the governments of the United Kingdom and the United States of America In Great Britain many French scientists, under the guidance of M Rapkine had worked with British scientists on many problems of both wartime as well as peacetime importance An important part of this work consisted in preparing numerous reports dealing with important technical and manufacturing processes and developments With the cessation of hostilities, the Mission was dissolved and replaced by the scientific offices of the French Embassy in London under the control of the Department of Cultural Relations but in close co operation with the CNRS

The U S A A similar organization also operated in the United States of America during the war and professional relations were maintained with a number of laboratories At the present time numerous missions are still being sent out to keep up these relations and in addition there is a permanent office of the CNRS under the Cultural Attaché at New York This office makes arrangements for the missions sent out to the United States and also purchases material The CNRS through the good work of this office was able to obtain a complete set of the scientific publications which had appeared in the United States during the war and to secure technical details about laboratory apparatus developed and manufactured in the U S A

Germany and Austria In March 1945 two months before the German capitulation the CNRS sent out missions with the armies behind the fighting front to Germany and Austria to protect restore and discover information about scientific installations and developments

At the end of the war it proved necessary to strengthen these missions and to set up a central unit generally responsible for directing the work This central unit consisting of officials paid by the CNRS was part of the French First Army (Second Bureau Section T) and until the dissolution of the First Army had its headquarters at General De Lattre de Tassigny s G H Q at Lindau

After the dissolution of the French First Army and the establishment of French military government in the zone of occupation this unit at first remained attached to section T in the occupation zone It was subsequently combined with the French F I A T under the direction of General de Saint Paul and the personal supervision of M Lafon General Administrator of Military Government

The object of the scientific surveys and inquiries was to discover

(*a*) the condition of laboratories after the withdrawal of the German troops

(*b*) the nature of the research carried out during the war and the progress made with it

(*c*) the financial and material resources of the laboratories

(*d*) what documents had been assembled by German scientists in the five years of war

(*e*) the mission was also responsible for local liaison with the T section of the Navy and Air Force and with the missions sent out by the various Ministries to recover property

An inventory of confiscated equipment (equipment from German laboratories which had worked for the war) was made at Bellevue by the committees before it was distributed In addition, the mission in Germany was able to make purchases of material which could not be obtained in France and which was necessary for the swift resumption of scientific activity

VII INTER MINISTERIAL CO OPERATION IN SCIENCE

The CNRS, as the above account would amply indicate, exists to promote and co ordinate all scientific activities, pure and applied, for which the Ministry of National Education is responsible financially or otherwise Many other Ministries and Government Departments have also established fine scientific laboratories for a long time and are involved in a considerable amount of research For example one need only recall Office National d Etudes et de Recherches aéronautiques, Ecole Polytechnique, Laboratoire central de l Artillerie and Laboratoire de Poudres under the Ministry of Defence (Forces Armées), Ecole Nationale des Ponts et Chaussees, Laboratoire central de P T T , and Laboratoire des Radio électricité, under the Ministry of Public Works (Travaux Publiques), Ecole nationale Supérieure des Mines and Ecole nationale des Moteurs à Combustion et à Explosion under the Ministry of Industry and Commerce, Institut National Agronomique, Ecole Nationale de Genie rural, Ecole Nationale Veterinaired Alfont Ecole Nationale d Horticulture and various agricultural research stations under the Ministry of Agriculture, Centre de la Recherche coloniale under the Ministry of Overseas France (France d Outre Mer) Centre Nationale d'Etudes des Télécommunications under the Prime Minister etc

The work of these important scientific establishments went unco ordinated for a long time Some kind of co ordination has of late been attempted by having the CNRS represented on a number of research committees and councils set up by these Ministries During the last three years the question of a more effective inter Departmental co operation has been given great attention and thought In April 1946, the Vice President of the Council of Ministers appointed an Inter Ministerial Committee to study the problems of reorganizing scientific research in the various Ministries and co ordinating their work It was first proposed that the CNRS should be given the status of a High Commission in charge of research in every Ministry but this proposal proved impracticable for various reasons After long discussions, the Commission finally recommended the establishment of a Council of Scientific and Technical Research, *Conseil Supérieur de la Recherche Scientifique et Technique* The Council which would consist of an equal number of representatives of scientific and technical research, would co ordinate the research work being done in all Government Departments and would assume full authority on all questions involving the allocation and use of funds The recommendations are at present under consideration by a special committee of the National Assembly

This is the story, as far as I have been able to assess, of the development of the French National Centre of Scientific Research It is still growing, its full potentialities are yet to be realized But unquestionably, it represents the most significant milestone in mobilizing and catalyzing science in France during the present century

REFERENCES

L Organisation de la Recherche Scientifique en France—Jean Perrin, 1938

Le Centre National de la Recherche Scientifique—Service Francais d Information April 1947

French Science—Past and Present—E.M Friedwald, *Discovery*, September and October, 1947

Organisation de la Recherche Scientifique en France—J Riviore *Revue Universelle des Mines* Liege, September 1948

Almanach des Sciences, Paris, 1948

PLACE OF PURE SCIENCE IN ENGINEERING AND INDUSTRY

PREM SARAN NIGAM

THOMASON COLLEGE OF ENGINEERING, ROORKEE

IS pure science a necessity or a luxury? This question is being answered by the researches in pure sciences which are becoming increasingly significant in connection with industry and agriculture Commercial enterprise finds itself confronted with problems which were beyond the powers of the inventor of an earlier generation and which today can be solved only by trained scientists The value of science in modern engineering, industry, commerce and agriculture is so widely appreciated that any lengthy discussion is quite unnecessary Exploitation of Nature by means of scientific knowledge is the most conspicuous feature in the history of civilization during the past two hundred years Since the middle of the eighteenth century, the western world has undergone almost as complete a metamorphosis as it did in the thousand years during which the Teutonic barbarians were changed into the civilized people of the Renaissance

At the basis of industrialism is the machine Both capitalism and wage employment are much older than industrialism and there were many factories before there was a factory system based on machine power But industrialism can be said to have begun when machinery driven by a central supply of power became the typical method of manufacturing production Industry replaced commerce as the directing force of economic life, and the scale of production and the forms of business organization came to be determined by the growth and character of machine power

There must be constantly increasing efficiency in production on the part of both labour and capital Only by everlastingly improving technical processes and lowering the costs of production can we obtain progressively higher standards of living So to try to accomplish this result in any other way means simply tugging in vain of our collective boot straps A broad dissemination of the benefits of technical progress is necessary to provide the market demands for an expanding industry

Quite commonly we hear modern industry called 'technological' industry One writer* states it a bit differently by reminding us that the economic activity of man has passed through three stages There was first the appropriative period in which man appropriated' commodities in their natural state For example, he picked and ate berries or nuts Later came the adaptive period which may be illustrated by the assembling of branches or stones to build a hut He is today in the creative period in which science is the handmaid of industry, and in which startling analysis and metamorphosis of commodities take place

Sometimes simple experiments lead to great events Great dams and momentous political issues accompanying them have their origin in the simple experiments of Faraday

There is a very interesting story which is told concerning the beginning of a new *rapprochement* between the theoretical and practical groups At the time of the Chicago World's Fair towards the end of the last century the famous German mathematician Felix Klein visited the United States and, in particular the World's Fair He was enormously impressed by the wealth of raw materials, the energy and the mechanical aptitude which he found in that country In fact, he was afraid that within a few years Europe would fail to compete with that rich new country The conclusion to which he finally came was that, in order for Europe to maintain her position, she must develop her engineering activities to such a high level of efficiency as to compensate for the natural advantages of America It was his conviction that this could best be done by applying the most advanced scientific technique and ability of his country to the problems of engineering and industry Upon his return to Göttingen, he accordingly began to build up a school of applied mathematics and mechanics and gathered around himself an extraordinary group of brilliant young scientists whom he trained to carry on the work Not only did he develop a new interest and point of view for mechanics but also exerted such an influence on his young colleagues and students that today they are scattered all over the world as leaders in the great effort to bring industry and science ever closer together Only a few names from this group need be mentioned to illustrate their wide spread influence today Prandtl, von Karman and Timoshenko are perhaps the best known, but they by no means exhaust the list

The great achievements of modern times are the fruits of persistent and organized efforts of hundreds of men in different countries bent upon finding out and understanding the secrets of Nature through the fundamental researches in pure science, and, when some inkling of these secrets has been obtained, its practical application in unexpected directions results The clear and straightforward record of science shows how frequently science—"the nursling of interest and the daughter of curiosity'—pursued for her own sake, has sooner or later proved her practical utility Aeroplane was only made possible by the development of the internal combustion engine and that this in its turn was only made possible by the development of the laws governing all heat engines, the laws of thermodynamics, through the use for the hundred preceding years of steam engine, and this was only made possible by the preceding two hundred years of work in celestial mechanics, that this was only made possible by discovery by Galileo and Newton of the laws of force and motion That illustrates the relationship of pure science to industry

---

* Slosson Creative Chemistry

Sir J J Thomson, while speaking to the Department of Scientific and Industrial Research, England, once said

> 'A research in the lines of applied science would doubtless lead to improvement and development of the older methods, the research in pure science has given us an entirely new and much more powerful method In fact research in applied science leads to reforms, research in pure science leads to revolutions, and revolutions whether political or industrial are exceedingly profitable things if you are on the winning side Pure science is the seed of applied science and to neglect it would be on a par with the action of the farmer who spent large sums on ploughing and manuring his land and then omitted to sow the seed

Speaking of science and industry it should be realized that their relationship is by no means simple Science is not a commodity which has simply to be added to the existing stock to improve it, nor is it entirely a method which can be applied uniformly to all branches of industry ' The scientist has three specific functions, first, he keeps watchful eye on quality of product, second, he improves manufacturing methods, and third he develops new products In keeping guard over the quality of product the scientist sets standards, works out suitable rapid measurements and supervises the carrying out of such measurements

The art of engineering as well as that of industry have been steadily built through the ages, but modern developments are, in the main, directly attributable to the advance of science

In fact, unlike civil and mechanical engineering electrical engineering did not exist at all before the physicist and the first electrical engineers were the great physicists Weber, Kelvin and others The common electrical units, the volt, ampere, ohm henry, farad, waft, are all—with one exception—named after renowned physicists Limiting ourselves to electrical power engineering, the pioneer dynamo designer Hopkinson, turned to Kelvin for enlightenment on the forces on conductors in slots in iron, and the great theoretical physicist and mathematician, Poincare wrote an important paper on the magnetic energy in alternating current power systems Turning towards communication engineering, we find that electronics was born in the great horse shoe magnet of Faraday

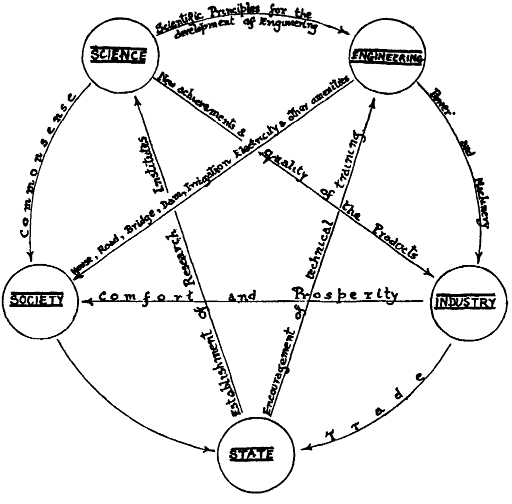
The evolution of radio has been rightly compared to a four storeyed building The top is occupied by Newton and Leibniz, the inventors of calculus, without which the discoveries of physics would have been too tedious and laborious The residents of the third floor are Kohlrausch and Weber who showed experimentally that the e m unit of electricity is larger than the e s u system by a number numerically equal to the velocity of light expressed in cm/sec The occupiers of the second storey are Maxwell and Hertz Maxwell was the propounder of the electro magnetic theory of light while Hertz found that waves similar in nature to light but of much greater wave length can be produced in a laboratory by purely electrical methods Bose, Marconi, Braun, Lodge and others have been put in the ground floor They led to the invention of wireless telegraphy proper

With the machines, there is a very great demand for good lubricants now a days Here we have the hard working industrial physicist contemplating an oil change His problem involves the basic physical principles of the classical hydrodynamics with just a touch of the occult and possibly a trace of the indeterminancy of the quantum mechanics The broad field of lubrication demands the attention of physicists, and basic work in the theory of the liquid state and surface phenomena should lead to results of immediate practical value

Those interested in civil and structural engineering will be aware of the fact that it is very difficult and sometimes impossible to find out the stresses in various complicated structures and highly redundant frames To the many advances that have been made in recent times in the field of science, the growth and development of photoelasticity mark a new chapter in engineering and heralds a new era in the domain of stress analysis As its name indicates, photoelasticity is a method of determining the elastic nature of a structure by means of photography, the actual process of stress evaluation being carried out on suitable models of the prototype by means of experimental optical methods

'If in the present stage of development the engineers designing an R C or steel dam tarried for mathematical elasticians to supply them with a reliable stress analysis the dam would not be built In fact today a few models and a photoelastic laboratory do easily in a few months what no mathematician could accomplish within a life time Nevertheless, it must be clearly known that this triumph of modern efficiency owes a deep and a very significant debt of gratitude to the theoretical labours of internationally renowned French mathematicians like Navier, Poisson and Cauchy, who developed elasticity and the closely allied analysis of wave motion from a mathematical basis Cauchy, in particular, by his elaboration of the elastic solid theory of light in about 1840, contributed to the physics from which the present photoelastic technique evolved and although this thory collapsed long since, it has left a substantial residue in widely used mathematical methods which are applicable to various branches in the field of applied science, of which photoelasticity forms one of the most predominant aspects' Then we must not forget the physicists who contributed to optics, the basis of photoelastic methods Huyghens elucidated the phenomenon of double refraction Brewster, in 1816, showed that a piece of glass when compressed behaves like a doubly refracting prism An exact relation between stress and relative retardation was established in 1854 by Weztheim Successive investigations were carried out by Wilson, Neumann Maxwell, Mach, Kerr, Pockels and others

On first thought it might seem that the metal industry is one in which the application of science is a comparatively minor factor Historically it is more than a probability that the first metal industry was entirely one of applied science If, as many historians believe, gold was man's first industrial metal it was recognized by its colour and its high specific gravity was used as a basis for its separation from the lighter weight rock material Furthermore, the 'panning operation provides a most interesting study in physics The operator must give Stoke s law for the fall of a sphere through a viscous medium, an opportunity to function Although this law was first used by Wilson in calculating the number of water particles in a laboratory fog, and hence the charge and mass of an electron, it is and has been for ages, the foundation of many ore concentration processes


Scientific Principles for the development of Engineering
SCIENCE
ENGINEERING
New achievements & Quality of the Products
House, Road, Bridge, Dam, Irrigation, Electricity & other amenities
Common sense
Institutes
Establishment of Research Institutes
Encouragement of technical training
Power and Machinery
SOCIETY
Comfort and Prosperity
INDUSTRY
Trade
STATE

Turning towards the chemical industries we can do no better than note the history of the dyestuff industry The first synthetic dye was made in England by Perkin but the industry soon found a congenial home in Germany where the practical layout of the businessmen is more often than anywhere else, enthused by that faith in scientific research which comes from first hand knowledge This gave a death blow to our indigo industry of Bihar

The ironmaster, the dyer, the soap and candle maker, the tanner, the potter and the glass manufacturer, were in existence centuries before serious attention was paid to the science underlying their work Conventions die hard and for a long time there was little enthusiasm to take advantage of what science had to offer It is freely admitted that the state of civilization attained before the advent of modern science was far removed from the conditions of life known to primitive man, but it is claimed that while science was so little developed industry had to look to experience as the only basis to work upon We admit that the inheritance was great for us and that the alchemist preserved much that was good in chemistry, just as the monks of the Middle Ages preserved much that was good in classical literature and architecture Experience accumulated slowly and at great cost had done great things but the rate of progress in industry during the past century is out of all proportion to what obtained in all the preceding centuries

Speaking of the value of pure science in engineering and industry the aim has not been to crown the scientist and give lower positions to the engineer or the technologist Far from it the best result can only be obtained when the engineer the scientist and the technologist each recognizing the limits of his own domain though the line of demarcation may often be difficult to define co operate with one another and mutually assist in the solution of social economic and industrial problems of their country The diagram showing the interdependence of science engineering industry State and society will more clearly emphasize the point

We are reminded often in our country of the distinction that exists between pure and applied research which are carefully put in watertight compartments Is it not unfortunate that any great stress be laid upon such difference even before we have made much progress in the field of scientific research ? It rather seems that here the scientist the engineer and the technologist have all too rarely tried to see their point of view or offered to lend a sympathetic hand towards achieving their aims Far too often they have remained perched on pedestals of their own erecting and have looked towards each other with indifference—an attitude out of which no constructive action has ever yet come forth They belong to the same family their efforts are not antagonistic but supplementary

When Heaviside the British mathematician was told that an American engineer had made a million dollars by the practical use of his theory on distortion less telephone circuit he replied that the American deserved a million dollars more for having understood his mathematics properly Thus we see that pure science and technology act and interact to the advantage of both and so it must always be While insisting on the essential distinction between them we must not forget that the two are in one sense parts of a whole which has a fundamental unity given by the consistent application of the scientific method to every sort of problem whatever the material and whatever the object No matter in which field the new discovery arises the net result is the enrichment of both art and science and a forward step on the way to that goal toward which thinking man seems irresistibly impelled—a better understanding of Nature s secrets

---

SALT TOXICITY AND PLANT GROWTH

K N LAL AND V S SREENIVASAMURTHY

PLANT PHYSIOLOGICAL LABORATORY COLLEGE OF AGRICULTURE HINDU UNIVERSITY BANARAS

INTRODUCTION

THE problem of salt toxicity and plant growth has been widely studied in different countries but the practical applicability of results to saline and alkaline soils has not been very encouraging This paper presents in a connected sequence the avenues of approach to this vital problem and elucidates the scientific principles involved in an analysis of salt toxicity phenomenon

NATURE AND DEFINITION OF SALT TOXICITY

Salt toxicity is defined as the adverse effect of an aqueous solution of a single substance upon living matter It may be of three distinct types—chemical physical and physiological Its toxic equivalent is defined as the least concentration that kills the roots in 24 hours[57] Toxicity is also expressed in terms of the number of ungerminated seeds left over after treatment with a salt solution Frequently it has been measured in terms of concentration that reduces growth to one half [26c] It is also represented as degree of tolerance that a species shows towards a particular salt solution measured in terms of the ratio of weight produced in high salt concentration to that produced in trace cultures

VEGETATION AND SALT TOXICITY

Degree of toxicity of various organic and inorganic compounds is more or less a specific property of the plant[35] Different species exhibit differential resistance to alkaline salts Even sorghum wheat and oats are known to resist salts of magnesium and sodium to varying degrees in pure solution Winter wheat is more resistant than spring wheat to sodium sulphate and sodium chloride Radicles of *Lupinus* resist iron and aluminium better than those of *Phaseolus*[51] Potassium fluoride on the other hand exhibits no differential effect in case of wheat, barley and rye Tolerance to lead salts also varies with the species[16] Toxic action of salts which precipitate calcium is restricted to algae and higher plants Magnesium injures higher plants but is not toxic to lower plants for which calcium does not appear essential Peachès are specially susceptible to arsenic Apricot shows similar effect but plum proves highly resistant

Development of certain plant communities and concentration of salt in soil appear related[29] Possibility of determining the percentage of sodium chloride by looking to the plant communities growing in such soils has been visualized There are certain species of plants which for instance, would indirectly seem to act as indicators of seleniferous soils[35c] Similarly cotton has been found not to grow in certain areas where formation of solonetz soil is going on although other species like *Convolvulus* grow successfully in these localities

SALT TOXICITY IN SOIL

Toxicity in black alkali soil is due to normal carbonate and bicarbonate of sodium, carbonates of potassium and lithium are rarely found Sodium silicate is also occasionally present In calcareous soils, alkali accumulates from hydrolysis of sodium zeolite Toxicity in black soil is sometimes due to soil being dispersed[7a] barium salts accumulate when the concentrated salt solution reacts with zeolite humus complex to replace Ca Mg, and K ions Toxicity in Indian alkaline soils is ascribed to (i) peculiarities of clay forming complex and (ii) abnormal amount of replaceable sodium and magnesium In *Reh* land, soluble salts of Na and Mg get deposited on the surface and cause marked injurious effect In arid localities, these salts accumulate to a large extent causing wide variation in texture, water supplying power and nutrient status of soil Growth of plants is rendered difficult Soil profile studies in such areas show that accumulation of salt takes place throughout the depth of soil with no marked zone Location depends upon agricultural operations, irrigation, rainfall and system of cropping Considerable shift in position is possible depending upon whether the water supplied counter balances loss due to transpiration or evaporation

Distribution of chlorates is very variable[44], whenever present, it is difficult to remove their toxic effect except by steam sterilization Chlorides and sulphates also reduce their toxicity[18a] Cations do not show any effect except in cases where ammonium ions are rapidly nitrified Chlorate toxicity also depends upon fertility of soil whereas arsenic and boron toxicity is correlated with texture alone Raising nutrient status, decreases chlorate toxicity but does not affect arsenic and boron toxicity Arsenic in colloidal form is more toxic than in non colloidal state[13] Form of arsenic compound is equally important[38c] Calcium arsenate toxicity varies with the quantity of soil colloids and their chemical composition Quantity and reactivity of iron determines the reaction colloids and their chemical composition Quantity and reactivity of iron determines the reaction between the colloid and calcium arsenate[13] Toxicity of sodium selenate, on the contrary, is little affected by soil colloids or phosphates but is markedly influenced by sulphate application[26a]

*p*H AND SALT TOXICITY

Soils where accumulation of salt is going on show an average *p*H of 7–9 Reduction in *p*H is caused by addition of a neutral salt *e g*, sodium and potassium chloride The reaction of the medium undoubtedly plays an important part in determining the degree of toxicity Injurious effect of potassium chloride and magnesium sulphate increases on both sides of *p*H 4 4–4 5 In *Pinus*, toxicity is less evident between *p*H 3 3 4 3 Injury increases above *p*H 7 0 when roots are affected In highly acidic or alkaline solutions, protective action of calcium is lost Rapid growth of root hairs takes place in neutral or slightly alkaline medium[22] Growth, acidity and concentration of salt appear related Toxic effects of high potassium fluoride is higher in acidic than in alkaline medium

Lack of calcium causes more damage to walnut seedlings than high concentration of hydroxyl ions Strawberry is very sensitive to alkaline conditions[31] Paddy, on the contrary, grows best in solutions of *p*H 6 4 7 0 while in acid ranges growth is hampered[19] Seedlings of western yellow pine grow best in acid medium Under field conditions however, other factors exhibit more influence on growth than soil reaction Hydrogen ions play a secondary role, for instance, in the toxicity of fatty acids and salycilic acid Again, *p*H is a less determining factor than concentration of salt in case of certain halophytes and non halophytes

Response of calcium and aluminium in *Phaseolus* and *Lupinus* is little affected by soil *p*H[51] In submerged water plants *p*H and aluminium toxicity are related Aluminium ions are suggested to exercise antagonistic effect on H ion toxicity and regulate absorption of other ions Antagonism between H ions[36] and others *e g*, Fe, Ca, Mg, K and N is also visualized with valency playing a decisive role Phosphate or nitrate ions are not absorbed from alkaline solutions of *p*H 7 6 or more[7b] Increase in *p*H raises potassium absorption and vice versa Similarly more manganese is absorbed at *p*H 6 7 in alkaline soil Mn absorbed is less than Fe

Soil reaction is largely regulated by the nature of soil bases Calcium sulphate buffers soil reaction and inhibits nitrification Calcium chloride causes slight changes in *p*H while magnesium, potassium, and sodium chlorides increase it markedly [52a] Soil reaction is controlled by the kind of soil base under going hydrolysis [52b], the latter also determines phosphorus fixing power of the soil Larger quantity of phosphorus is fixed if Mg or Ca is the reacting soil base Soil acidoids and single base soils behave like true acids and salts respectively in their reaction with carbonates[47]

SALT CONCENTRATION AND TOXICITY

All salts prove to be toxic to plants above a certain concentration In areas with 5 per cent salt no growth is found possible Restricted growth in 0 42 per cent of salt is observed in some plants while many others tolerate even as high as 1 2 per cent[9] Safe limit for chlorine is 1 ppm in poor soil and 2 3 ppm in rich soils Injury starts at 10 ppm and increases with concentration [37] Its optimum concentration for reeds is 50 ion gram concentration In wheat, chlorine injury is mild in 0 0001 M solutions Cobalt chloride in 0 01 M shows toxic symptoms in 36 hours Chlorides of cobalt, iodine and zinc are relatively more injurious than those of aluminium manganese, lithium and sodium [50a] Lead chloride even at 160 ppm shows no deleterious effect Weak solutions of sulphates and chlorides of calcium, nickel and copper cause little or no damage [13b] Strength of solution and duration of contact are important factors determining the response Acetates of copper, mercury and lead are toxic even in 0 0001 N concentration [9] Sodium salts depress growth when their concentration is above 500 ppm Development of toxic symptoms takes time to appear in some cases they are evident only towards the end of life cycle [30] Calcium is helpful within a range of 16 32 ppm [38] Zinc sulphate is toxic above 0 001 per cent Lead salts prove equally toxic above 5×10^{4} or 10^{5} lead ion concentration [38] Apples and grapes are known to tolerate 200 ppm of lead but exhibit depression in growth as copper content rises from 10 to 30 ppm Iodine and nickel are highly injurious in 40 106 ppm and 0 59 ppm concentration respectively [17] Thallium sulphate produces toxic effects at 2 1 ppm in sandy loam [42a] Selenium exhibits snow white chlorosis in cultures containing 1 ppm of this element [33b] Even metals *e g*, gold, platinum and aluminium kept at a distance of 2 3 mm are known to cause injurious effect on germination of white mustard seeds[43]

Sodium arsenate used as spray proves toxic between 60 and 160 ppm Equivalent amount of arsenic as lead arsenate is less toxic Arsenic has been found to stimulate certain plants *e g*, apples and rye in 20 ppm concentration but depresses growth of grapes Arsenic toxicity is also recorded in different types of soil [18i]

Organic compounds like vanillin, eocene, erythrocene, methylene blue gentian violet and rose Bengal are toxic even in very dilute solutions Mercochrome, on the contrary, shows no such effect In general toxicity of normal aliphatic alcohols increases [56] with their molecular weight [54c] [14] Toxicity of aldehydes does not increase as homogeneous series is ascended Pyroluric acid and lactic acid too show toxic effects upon protoplasm [15f] Phenols cause immediate exosmosis of electrolytes from cells [16] Aromatic acids on the other hand, lose ions to the roots for varying periods and then receive them back from roots after lapse of some time Such effects are more marked in acidic solutions Some correlation between the structure and toxicity of molecules is noted in these cases as well

TOXICITY AND ANTAGONISM OF SALTS

Toxicity is usually defined as the adverse effect produced by an aqueous solution of a single salt while antagonism indicates the hindrance that a given salt exhibits upon the toxic action of another salt Toxicity may be chemical physical and physiological, while antagonism is classified as positive zero and negative Antagonism between certain elements is now an established fact [45] Calcium sulphate is known to overcome toxic effect of magnesium and sodium salts [35] Injury to wheat oats rye and barley is found to increase as the magnesium calcium ratio is raised from 1 50 High magnesium is injurious to peach in absence of adequate quantities of available potash [31], magnesium acts antagonistically to calcium even in mitosis processes of the cell Inhibitive effect of lactic acid on cytoplasmic fission is antagonized by calcium chloride [15] but not by potassium or sodium chloride and that of pyroluric acid by potassium chloride and sodium chloride

Pronounced antagonism between sodium and calcium and magnesium and calcium have also been recorded in case of algae In three salt solutions, calcium is antagonized by both Mg and Na Sodium chloride toxicity is partially removed by calcium chloride [24] Calcium and copper ions too antagonize sodium toxicity in wheat grapes, pea and tobacco In *Lupinus* and *Phaseolus*, antagonism between Ca and Fe and Al is also recorded [51] Boric acid is claimed to antagonize the harmful effect of certain elements Selenium toxicity is antagonized by sulphur application [33a] Injurious effect is not noted in selenium sulphur ratio of 1 12 or less in total absence of sulphur, selenium in 1 ppm concentration indicates definite injury As high as 18 ppm is known to be tolerated if 192 ppm of S be present Its absorption varies directly with the amount of available selenium and inversely with the concentration of sulphate within certain limits [33d] Excess of sulphur prevents selenium absorption but intake is never stopped totally Antagonism of Ca to K and K to Ca plays an important part in the absorption of nutrients

Toxicity of arsenic decreases with time Heavy leaching reduces concentration of arsenic in soil Toxicity of this element varies inversely with the quantity of phosphorus present [33a] and is suggested to be a function of availability of phosphorus with a protective As/PO_4 ratio of 1 5 [33e] Rubidium toxicity similarly is suggested to be a function of K availability with a protective Ru/K ratio of 1 2, strontium toxicity is again a function of calcium availability with a protective Sr/Ca ratio of 1 1 Elements are, therefore, suggested to play a nutritive as well as antagonistic function One effect may predominate over the other at some stage, still at others, simultaneous exercise of both the functions might be evident

Cases of antagonism between anions are also on record Thus antagonism between acetate and sulphate ions is of as great significance as antagonism between cations [48] Similarly antagonism between sulphate and chloride ions and between nitrate and chloride ions have also been observed

RELATIVE TOXICITY OF IONS AND MOLECULES

Equivalent quantities of various ions or molecules do not exert the same influence Sodium carbonate shows more toxic effect than sodium chloride in nitrification processes in soil Sodium sulphate is more toxic to wheat than sodium chloride Injurious effects differs with species Neither sodium nor chlorine ions are more toxic than other tested ions of normal solution *viz* , K, Cu, NO or SO Further about 4 5 times as much chloride as hydroxide of Ca is needed to bring about the same amount of growth[21] Solutions of magnesium and calcium chlorides do not remain equally toxic when diluted to the same extent Again, calcium nitrate reduces the toxicity of high manganese concentration and lowers the stimulating effect of lower manganese chloride concentrations [4] On *Phaseolus* and *Lupinus* iron ion shows 5 10 times more toxic effects than the hydrogen ion[51] In *Aspergillus niger* the relative effects of different ions follows the order (*i*) lithium, ammonium, sodium, rubidium, and caesium, (*ii*) berrylium, calcium, strontium and barium, (*iii*) fluorine, chlorine, bromine and iodine, (*iv*) zinc, cadmium and mercury, (*v*) copper, gold and silver, (*vi*) sulphate chloride and nitrate, (*vii*) chlorate, bromate and iodate, and (*viii*) perchlorate [59] No definite relationship between toxicity and stimulation of growth is noted In general, toxicity of a salt is known to depend largely upon the component anions and cations and also the entire molecule [7] A definite order of toxicity of alkaline salt has also been noted depending upon the time the plant is in contact with the salt during the period of adaptation

SALT AVAILABILITY AND ASH CONSTITUENTS

Application of sodium chloride increases ash content to the extent of 32 per cent [30] The larger the percentage of this salt in soil the greater appears to be the rapidity of its increase in ash, In sodium bicarbonate cultures, plants do not show such high ash content on account of lesser mobility of this salt over sodium chloride Calcium, magnesium and silicon uptake too is affected markedly by the form of sodium applied High sodium nitrate in soil decreases potassium content while effect of smaller concentration is variable Contrary to this, sodium nitrate is also known to increase K_2O content [30] Calcium content also decreases more than magnesium content[31b] No relationship between Ca and Mg content of soil solution and soil *p*H has been recorded though a definite relation between calcium content of plant and soil is noted [23] Continuous cropping reduces calcium content and magnesium content of soil Specific ion mobility and absorption quality of cations greatly influence the physiological effects produced Absorption of magnesium is controlled by the amount of sodium or potassium present [11] and is complicated by the base exchange relationship and availability differences in soil [12] In weak concentrations the ratio of elements absorbed relative to external concentration (absorption ratio) is high, in strong sloution this ratio stands at less than unity Rate of absorption of ions from a substrate is, therefore, not a direct function of their relative velocities or any other known physical or chemical property but is largely regulated by the life requirement of the species and the environmental complex surrounding the plant

Calcium content of tissue increases as the concentration of this ingredient increases in soil Of all elements, K is most readily absorbed followed by Na, Ca and Mg Absorption of twin ions in different quantities and the predominating role of an element [2,34,41] in determining the absorption of another are established facts [45] [46] Plants exhibit symptoms of potassium deficiency when Ca or Mg or S is not fed to them Manganese again, is absorbed more than iron in acidic condition while in alkaline, the reverse is the case This shows that *p*H of the medium is equally important in intake of salt Content in plant is directly or inversely proportional to the external concentration of elements [40] depending upon their known chemical properties and physiological importance[3]

SALINITY AND GROWTH

Cations in general, and anions like aluminates and cyanides in particular, produce definite toxic effects Coagulation and flocculation of cytoplasm is caused by weak solution of K, Na, Ca, Mg, Zn, and Al [1] Magnesium chloride is more beneficial than calcium chloride, the former acting as a prophylactic agent Flax seeds germinate better in darkness in presence of magnesium sulphate The longer the treatment, the lower is the concentration giving neat germination Principal roots are more affected than laterals Beneficial effects in paddy are also recorded when $MgSO_4$ forms part of a 4 salt solution Magnesium nitrate and monobasic magnesium phosphate cause chlorosis and drying of leaf tip, the toxic effect is more evident when the former is not balanced with calcium Respiration and catalase activity are also hindered

Potassium and magnesium salts are favourable to some, unfavourable to others and in still other cases exhibit no definite effect Magnesium toxicity causes hampered emergence of leaf in the form of a spiral [55a], frequent abscission of leaf tip is also noted Injury increases as Mg Ca ratio increases from 1 50 Calcium chloride alone injures growth of mustard, in strawberry, excessive calcium reduces fruit bud formation Swelling, branching and curvature of root hairs in weak solutions and burning and irregular development of hairs [22] in strong solutions are noted Excess of calcium causes incipient chlorosis in beans and discoloration, rolling and falling of leaflets in lupines High Ca in soil also interferes with protein metabolism of lupines In corn, diminution of total acidity in inverse proportion to Ca is noted.

Leaf burn and reduction in leaf size are noted in saline irrigated soils [27] Length and number of stem in *Aspergillus* are affected [49] Water containing 2 3 3 4 gms of sodium chloride per litre shows disastrous effects on tomato High concentration of sodium chloride and sodium bicarbonate also inhibits growth in pot cultures [30] Toxic effect varies with age Slightly useful effects of high salt concentrations is noted during early stages [39] Plants with 2000 ppm of these salts are resistant to wilting Sodium nitrate and potassium nitrate applied at 30 and 60 lbs N per acre are highly toxic to moss [6] The effect is immediate and cumulative Potassium fluoride in high doses is less toxic to rye, wheat and barley

Lead sulphate is neither harmful nor beneficial, while lead chloride evinces harmful effects on wheat, barley, oats, pea and bean [10] In 0 1 0 2 percent these inhibit germination [21] Thorium, zinc and berryllium are less toxic Copper stops growth of seedling while thallium kills the seed when present above 10 ppm [32] Selenium at 1 ppm causes snow white chlorosis Toxicity of sodium selenate is neither reduced by soil colloids nor by phosphorus supply but is influenced by sulphur application [32a] Chlorides in high concentration are toxic [5], in weak solutions they increase growth [50b] Their requirement is most during early stages Acetates of Ba, Pb, Hg Ca, Zn, and Cu increase growth in very weak solutions in stronger solutions, browning of cell membrane and depression of root growth are noted[8]

CONCLUSION

Evidences cited in the previous pages indicate how maladjustment in the physico-chemical and physiological processes of the plant causes development of toxic symptoms Changes in the colloidal properties, in the rate of absorption of water and nutrients, in the intensity of respiration and enzymatic activity and in the growth and development of crops are noted as malnutritional symptoms of salt toxicity There appears to be a critical limit of salt concentration below which stimulative effects are noted for majority of salts and above which baneful effects predominate This problem of concentration relationship is further complicated by the presence of ions of definite antagonistic behaviour, the nature of soil colloids, the *p*H of the medium, the prevailing conditions of edaphic and climatic factors, the specificity of the plant, the age of the tissue undergoing adaptation and above all the growth requirements of the species It involves, therefore, study of the problems of pedology in certain cases in still others, it requires careful analysis of the associated problems of soil chemistry, agronomy and plant nutrition How far toxicity in soil is related to the biological essentiality of the elements [53] and their concentration and to what extent the nutritive or antagonistic functions predominate in different soil types requires careful investigation Detailed investigations are also needed on other related problems for instance, the analysis of the toxic effect of various ions on growth and metabolism of crop plants both under conditions of pot culture and fields, the determination of optimum ratios of these salts conducive to best development and high yield, and the role of soil factors such as *p*H, soil colloids soil bases, and moisture content on the degree of toxicity exhibited by individual salts Until these aspects of the salt toxicity phenomenon are worked out from varied angles of vision, no permanent solution for raising better crops in such tracts rich in salt would be forthcoming

REFERENCES

[1] Addoms R M *Amer Journ Bot*, *14* (3) : 147 65, 1927

[2] Aspray, G P *Proc Roy Soc* B *112* (778) 451 72, *113* (780) 71 82, 1933

[3] Bechenbach J R *et al* *Soil Sci* *45* (5) : 403 426, 1938.

[4] Barton, L V and Sam F Trelease *Bull Tor Bot, Club,* *54* (7) 559 1927

[5] Baslavskaja S S and S M S Syroeskina, S M. *Plant Physiol* *11*, 1936

[6] Beaumount A B : *Science* *75*, 312 313, 1942

[7] Breazeale J F (a) Ariz Expt Stat Tech Bull *14* 337 57 1927 ((b) *Ibid* *41* 1932

[8] Bill W B and J Patterson *Ann App Biol* *13* (2): 157 159 1926

[9] Bourn, W S *Boyce Thompson Institute*, *6* (3) 303 308, 1934.

[10] Brenchley W E (a) *Ann App Biol.*, *21* (3) 398 417; (b) *ibid*, *25* (4) 67 94 1938

[11] Brown D D *Soil Sci* *26* 441 446, 1928

[12] Carolus, R L : *Proc Amer Soc Hort Sci*, *33* 595 99, 1927

[13] Carr R H *Proc Indian Acad Sci* *36*: 185 187, 1927

[14] Carter, F M : *Protoplasma*, *21* (4) 615 29, 1934

[15] Chalkley, H W and G E Daniell *Protoplasma*, *21* (2) 258 269, 1934

[16] Chrysostum, M M *Amer Journ Bot*, *23* (7) 461 71, 1936

[17] Cotton, M Bull *Torrey Bot Club*, *57* (2): 127 140, 1930

[18] Crafts A S : (a) *Journ Agri Res*, *58* (9): 637 671 1939 (b) *Hilgardia*, *12* (3) 177 200, 1939

[19] Dastur R H, and J Winfred *Journ Ind Bot Soc* *17* (4) 255 68 1938

[20] Davidson, J *Journ Agri. Res*, *35* 335 46, 1927

[21] Dilling, W J *Ann. App Biol*, *13* (2) 160 67, 1927

[22] Farr, C A *Amer Journ. Bot* *14* (10): 553 564, 1927

[23] Fonder, J F *Soil Sci*, *26* (6) 415 31, 1929

[24] Gahlen K *Protoplasma* *22* (3) 337 301, 1934

[25] Gibbs, W N *et al* *Soil Sci*, *19* 371 380, 1925

[26] Gile, P L (a) *Journ Agric Res*, *52* (7): 477 91, 1936 (b) *Ibid*, *57* (1) 1 20, 1938, (c) *ibid*, *56* (10) 787 89, 1938

[27] Haas, A. R. C *Bot Gaz*, *87* (3) 364 96, 1929

[28] Hammet, F *Protoplasma*, *4* (3) 183 191, 1929

[29] Harris J A *Journ Agric Res*, *37* (4): 213 231, 1928

[30] Heller, H : *Plant Physiol*, *15* 1940

[31] Hoagland, D R : (a) *Journ Gen. Physiol*, *5* 629-47, 1923. (b) *Plant Physiol*, *3*: 473-486, 1938, (c) *Proc Amer Soc. Hort Sci.*, *29* 267 271, 1932, (d) *ibid*, *30* 288 294, 1934.

[32] Horn E E *Science* *8* (2068) 167 168 1934

[33] Hurdkarrer A M (a) *Science 78* (2033) 560 1933 (b) *Journ Agric Res 49* (4) 343 357 1934 (c) *Journal Wash Acad Sci 26* (4) 180 81 1936 (d) *Amer Journ Bot 25* (9) 666 75 1938 (e) *Plant Physiol 14*(1) 9 29 1939

[34] Jacobson and T R Swanback : *Plant Physiol 8* 340 42 1933

[35] Kearney and Harter *Ag Journ Ind 3* 1908

[36] Knudson L *Journ Amer Soc Agron 17* 711 176 1925

[37] Krone P R and F F Weinard *Proc Amer Soc Hort Sci 27* 444 48 1930

[38] Larson H W E *Soil Sc 25* (5) 399 408 1928

[39] Lipman C B *Soil Sci 22* 1936

[40] Martin A L *Amer Journ Bot 23* (7) 471 83 1936

[41] McCalla A G and E K Woodford *Plant Physiol 13* (4) 695 712 1938

[42] McCool M M (a) *Boyce Thomp Inst 5* (3) 289 296 (b) *Journ Amer Soc Agron 22* 434 437 1930

[43] Nadson G A and E A Stern Dok *Adad Nauk U S S R 2* (2) 93 99 1935

[44] Owen O *Pom and Hort Sci 7* (4) 270 75 19 9

[45] Osterhout W J V *Bot Gaz 44* 259 72 1906

[46] Puffeles M *Journ. Amer Soc Agron 31* 1939

[47] Puri A N and M L Puri *Soil Sci 46* (5) 401-408.

[48] Raber O L *J Gen. Physiol. 2*: 541 544 1920

[49] Rudolf M *Bot Gaz 83* (1) 94 98 1927

[50] Singh B N and S Prasad (a) *Ind. Journ Agric Soc*, *6* 3 1936 (b) *Proc Ind Acad Sci* B *3* 4 1938

[51] Skeen J R *Soil Sci 27* (1) 69 80 1929

[52] Spurway C H (a) *Journ Amer Soc Agron. 18* (6): 497 505 1926 (b) *Soil Sci 21* (1): 71 74 1926

[53] Steinberg R A *Journ Agric Res 57* (1) 851 858 1938

[54] Stiles W and F Kidd (a) *Proc Roy Soc* B *90*: 487 504 1919 (b) *ibid 90*: 448 470 (c) *Protoplasma 13* (1): 1 20 2 363 73 1931

[55] Trelease S (a) *Bull Torrey Bot Club 58* (7) 127 148 1931 (b) *ibid 53* (3) 137 156 1926 (c) *Amer Journ. Bot 26* (5) 339 341

[56] True R H and Bartlett, H H *Amer Journ Bot 2* 255 78 1915

[57] True R H and Rodney H *Proc Amer Phil Soc 69* (4) 231 245 1930

[58] Uppal B N *Journ Agric Res 32* (11) 1069 1099 1926

[59] Wachstren s \ *Planta 23* (1 2) 177 224 1934

MEASUREMENT OF SHEAR STRENGTH OF SOIL

S P BAIDYA

SOIL MECHANICS LABORATORY DAMODAR VALLEY CORPORATION CALCUTTA

THE shear strength of soil is defined to be the strength which the soil mass exerts in order to resist any external force tending to deform it It consists of its cohesive strength and frictional resistance among the particles The relation between the normal stress P on every section through a mass of cohesive soil and the corresponding shearing resistance S per unit area as represented by C A Coulomb is

$$s = c + P\tan\phi \qquad (1)$$

where ϕ = angle of internal friction

c = cohesive strength per unit area

For non cohesive sand $c = 0$ so $s = P\tan\phi$ When the normal stress $P = 0$ c represents the cohesion which is equal to shearing resistance per unit area The values of c and ϕ are determined by measuring the resistance in a horizontal plane section through the soil at the different values of normal stress P The apparatus used for the purpose is of the model designed by an eminent soil scientist Prof A Casagrande It consists of a metal box of sq base about 2 inches in height divided horizontally in two halves It is placed above the ground by means of two horizontal parallel beams supporting it at its two edges The soil to be sheared is placed inside the box The soil is held tight by means of metallic ribs at the top and bottom of it Fine wire meshes are placed behind the metallic ribs for drainage The top of the box is covered with a metal plate just fitting inside it On this plate at the centre there is a metal ball carrying metal ring hanging vertically round the box The ring passes through the space between the beams The normal load to be applied to the soil is placed on a loading device attached to the lower end of the ring The lower half of the box is kept fixed with the beam while its upper half moves with the normal load under the action of the horizontal force The latter is produced by a vertical loading device one end of which after passing over a pulley is attached to the upper moveable part of the metal box The displacement of the moveable portion of the box is recorded by a guage measuring to 1/1000th of an inch

The soil to be tested is compacted in a hydraulic jack at optimum moisture content to about 95 p c of the A A S H O density Sand is taken in the box in the dry and loose state The compacted soil or sand in the dry and loose state under a fixed normal load is then sheared gradually under the action of horizontal force produced by adding equal weights to the vertical loading device until no further deflection could be observed The deflection corresponding to each addition

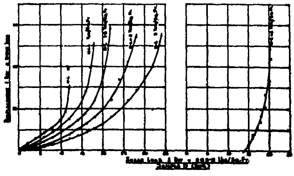


Fig 1a Fig 1b

to the shear load is recorded by the measuring gauge The total displacement for each load is plotted against the corresponding total shear force The process is repeated with a number of different normal loads and such graph for each of them are drawn as shown in fig 1c and fig 3c

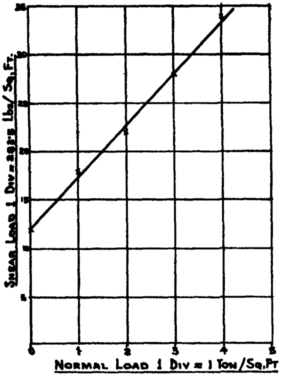


Fig 1c

1 The values of c and ϕ are calculated from the straight line drawn with shear load at failure of the soil against the corresponding normal loads obtained directly from the experiment

2 The values of c and ϕ for all soils including sand may be calculated from the following theoretical consideration Clay in presence of water in a soil produce a force which changes with the change of moisture content of the soil As the water content decreases the force in the mass increases and the mass changes from the liquid to plastic then to solid state The force developed in the mass binds the particles with each other in it In the plastic condition the binding force is feeble and the medium behaves like fluid In the solid state this force is strong enough to hold the particles fixed in position in the mass When a load is placed on a plastic soil mass confined in a container the plastic medium transmit the load to the wall of the container The pressure due to the load is distributed equally on all directions of the particle surface of the soil by the plastic medium Therefore the action of the load on the particle surface in producing the internal friction is neutral If, however, the plastic medium under the load gradually changes in the solid state, unless the load is too heavy, the mass supports the load in unconfined condition The load is distributed on the surface of the soil particles by the cohesive force of the medium This force produces an elastic property to the medium due to which the medium opposes the tendency of the soil particles to come in contact with each other under the action of the load If the soil in the solid state be surrounded by a flexible boundary and a constant lateral pressure be maintained on the wall of the boundary each load increment on the top of the soil react against the lateral pressure through the cohesive medium, due to which the medium is under strain The amount of strain produced in the medium is proportional to the resultant stress (here lateral pressure and normal load) acting on the soil Due to strain the strength of the cohesive medium decreases The action of load on the particle surface in producing resistance due to internal friction of the particles remains neutral until the resultant stress increases to such an extent that the medium is completely strained to failure In that case the cohesive force reduces to zero Any stress increment further to this directly act upon the soil particle and the deformation due to this is obstructed by the frictional resistance of the soil

Hence in Coulomb's equation ϕ 0 so long as ($s \gtreqless c$) shearing stress is less than the cohesive strength of the soil

Let an uniform stress be applied normally all over the surface of a cohesive soil mass If any plane section be considered in the soil the stress may be resolved into two component parts, one is normal to the plane while other along the plane The normal component of the stress tends to flatten the plane on all directions along the plane while the component parallel to the plane tend to obstruct this flattening If the plane be horizontal and the component of the stress parallel to the plane disappears then the plane flattens under the action of vertical stress So long the vertical stress does not exceed the cohesive force of the soil, the soil does not yield but deform in horizontal directions, the deformation is resisted by the cohesive force of the medium If the soil column be sorrounded by a rigid boundary the deformation (or bulging) of the soil under the vertical pressure is opposed by the boundary Due to this any point mass within the soil offer resistance to horizontal strain greater than that, when the soil is unconfined With the increase of the vertical pressure the amount of deformation (or bulging) of the soil column in unconfined condition increases, so the rigid boundary offers greater force of reaction to oppose this Due to this the resistance to horizontal strain of the soil in confined condition increases with the increasing vertical stress So in the process of shearing of a soil column confined within a rigid boundary, in a horizontal plane dividing the boundary, the area of the plane sheared by a shearing force depend on its force of resistance to horizontal strain developed by the normal stress in the plane In fact the shear plane has some thickness however small and the process of share of a cohesive soil involves deformation of the plane in the direction of the applied shear force Theoretically the displacement of the shear plane under various normal loads should remain same at the failure of the cohesive force of the soil Practically it decreases with the increase of the normal load due to the confined condition of soil by the rigid boundary Since sand does not possess cohesive medium during the process of shearing it is the frictional property of sand that resists the movement of one plane over the other, and the area sheared under various normal pressures is independent of the rigid boundary If Dp (fig 2) be the total displacement due to shear load s under the normal load P and D_c be that due to the shearing against its cohesive strength then D the displacement sheared against the frictional force of the soil is given by

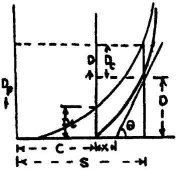


Fig 2

$$D = (D_p - D_c) \qquad (2)$$

The cohesive force C is independent of normal stress P, while the horizontal strain D_c depends on P D_c decreases with the increase of P

When the displacement corresponding to the frictional force is plotted against the total shear force of the soil under the normal load P, the equation to the tangent to the curve at a point having the displacement $(D_p - D_c)$ is

$$(D_p - D_c) = (s - C - x) \tan\theta \qquad (3)$$

where s = shear load corresponding to the displacement on the curve

x = interception between the point C and the tangent on the load axis,

$$\text{if } x + C = X \qquad (4)$$

then equation (3) becomes, $(D_p - D_c) = [P\tan\phi - (X - C)] \tan\theta$ (5)

In case of sand, $C = 0$, $D_c = 0$

$$D = D_p = (P\tan\phi - X) \tan\theta \qquad (6)$$

The equation (6) represents a curve drawn with total displacement against total shear load for sand under the normal load P The origin of the curve is shifted to $(s = 0, D_p = 0)$

The equation (5) shows that in the case of soil the origin of such a curve is at $(s = C, D_p = D_c)$

The area sheared corresponding to the frictional force of a soil under different normal loads depends on the orientation of the soil particles in the plane of shear Hence when the displacement $(D_p - D_c)$ remains constant for a soil under various normal loads, ϕ and θ remain constant

The equation to the tangent at the point, having $(D_p - D_c)$ same, to the curve drawn with the soil under the normal load p is,

$$(D_p - D_c) = [p\tan\phi - (X' - C)] \tan\theta \qquad (7)$$

X′ = the interception between origin (0, 0) and the tangent to the new curve on the load axis

Comparing equation (7) and equation (5), we get,

$$\tan\phi = \frac{X - X'}{P - p} \qquad (8)$$

$$\text{But, } \tan\phi = \frac{s - l'}{P - p} \qquad (8a)$$

Where l' is the shearing force at the point on the curve of normal load p

$$X = X' + (s - l') \qquad (8b)$$

If $P = np$, then $P\tan\phi \quad np\tan\phi - n(l' - C)$ (9)

Let $(l - C) - l$, then l represents the shearing force corresponding to the frictional resistance of the soil under the action of normal load p

$$\text{Hence } X = X' + (n - 1)\,l \qquad (10)$$

Equation (10) shows that the tangent to a curve of normal load p at a point, which corresponds to an angle of internal friction ϕ, moves parallel to itself along the load axis towards increasing shear value to (n − 1) times its frictional force to touch a curve of normal load np at the point, having the same angle of internal friction ϕ

In equation (9) when, $\phi = 0$, l –C, $l = x = 0$ Hence equation (10) with the help of eqn (4) gives $X = X' = C$

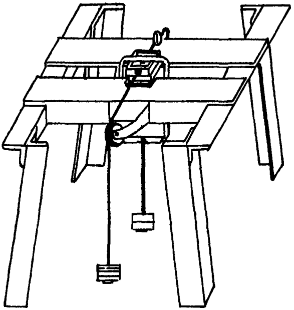
This shows that all the n number of curves start from the origin at $s = C$, $(D_p - D_c) = 0$

At failure of the soil $\phi = \Phi$ say, and $p\tan\Phi = L$, then, $X' = (L + C)$ $X = (nL + C)$

Further $X + (D_p - D_c)\cot\theta = s$ equation (5) gives $S = np\tan\phi + C$ i e $s = nl + C$

Hence, it may be shown that if there are n number of displacement-shear load curves drawn with a soil under the normal loads p, 2p, 3p, np, with their origin at (0, 0) they may be made lie on a single curve of normal load p having its origin at (C, 0) This curve is drawn with displacement corresponding to frictional resistance (i e , $D_p - D_c$) of the soil against the shear load The displacement ($D_p - D$) on the curve of normal load np at the shear load ($C + nl$) is shifted to the shear load at ($C + l$) to lie on the curve of normal load p

In the case of sand when ϕ 0 l — C — 0 X — X — 0 Therefore all the n number of curves start from the origin at (0 0) At failure X l therefore X — nL then nL is the shear strength at failure of the sand under the normal load P That is the shear load at failure corresponding to a curve of normal load np is n times heavier than the shear load at failure corresponding to a curve of normal load p Hence in the case of sand it may be shown that if there are n number of curves drawn with total displacement against total shear load at fixed normal loads p 2p 3p np they may be made lie on the single such curve of normal load p by shifting their displacement corresponding to various shear load nl to the shear load at l



The points on the curves for soil in fig 1a and for sand in fig 3a are shifted to lie on the single curve of normal load 1 ton per sq ft in fig (1b) and fig (3b) respectively The angle of internal friction ϕ for sand and soil is determined from the shear load observed at failure point on a single representative curve drawn through the points shifted from the curves of various normal loads In case of soil the value of C should be known previously C is determined directly where possible from the shear value at failure when there is no normal load otherwise its value is adjusted by trial so as to get the best coincidence of these points

It may be remarked that inspite of wide variations in the result obtained by two different procedures there is a general agreement among these results The result obtained from the straight line relationship was determined from the point on each curve at the failure condition of the soil Complete failure of a soil depends on the nature of reaction produced in the plane of shear against the shearing force In sand the reaction appears in the form of surface resistance, while in clay soil it appears in the form of distortion of soil mass on both sides of shear plane due to plastic deformation Surface resistance simply increases the angle of internal friction to a constant value The effect of distortion disturbs the true failure of the soil Due to this it is very difficult to get accurate values of C and ϕ of a clay soil from its failure point The coincidence of the displacement shear load curves, besides giving the method for determining the value of C and ϕ reveals the true mechanism of the cohesive medium of a soil under stress with regards to the distribution of the stress over the surface of non cohesive particle in it (see Table)

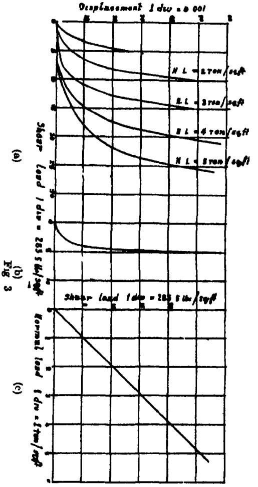


Fig 3

Following points may be noted regarding the test

1 Soil was compacted in hydraulic jack at optimum moisture content The density of the compacted cake was about 95 p c of A A S H O density

2 Compacting pressure was 25 Tons/sq ft for all soils Prior to test the soil was left for some time to be consolidated under this pressure The maximum normal load used during test was 5 Tons/sq ft

It is therefore expected that no consolidation of the soil under normal load could occur The cohesive strength of the soil under various normal load therefore may be taken to remain constant

Samples	Gravel %	Coarse sand %	Fine sand %	Silt %	Clay %	Optimum moisture content %	Dry density in lbs cu ft	From straight line relationship C in lbs sq ft.	From straight line relationship ϕ	From the method of coincidence C in lbs sq ft	From the method of coincidence ϕ
1		99 0	1	—		—	101 5	0	33° 2	—	32° 2
2	2 5	55 8	26 8	6 9	7 9	10 4	124 3	964	33° 3	1134	37° 2
3	2 6	49 8	29 1	3 5	9 9	12 9	123 3	510	37° 0	311	41° 0
4	1 0	44 6	32 6	8 7	12 9	11 6	126 6	623	35° 3	567	35° 9
5	19 5	28 5	21 6	10 1	20 4	11 8	125 5	1414	45° 3	1606	45° 2
6	2 8	11 9	38 4	23 5	23 2	14 7	119 7	2183	36° 2	2268	34° 9
7	0 4	8 3	39 3	28 1	23 8	12 9	120 0	4536	25° 1	4819	23° 9
8	0 7	29 1	33 7	10 5	26 0	12 1	127 3	3855	26° 8	3900	24° 5
9	0 8	22 3	22 4	20 5	33 9	13 7	120 0	3402	35° 0	3969	37° 1

BIOLOGICAL EFFECTS OF METHOXONE ON WATER HYACINTH

UHALA TIN PARUKUTTY BARUAH AND H K BARUAH

BIOLOGY DEPARTMENT, UNIVERSITY OF RANGOON RANGOON

IN studies of control of diseases causing extensive wastage of important crop plants as well as of fruits and vegetables, the application of potent chemical substances as suitable fungicides has been recognised as one of the means to combat onslaught by fungi and bacteria In this search for suitable fungicides many new chemical substances such as diphenyl, ortho phenol gammexane, D D T , and other organo metallic compounds have been discovered and methods for their application and their inhibitory properties determined In the same way, certain grasses and weeds grow so very luxuriantly as to prove a menace to important economic crops in the field and the loss sustained by the farm crops due to the growth of weeds appears to be considerable The eradication of weeds has, therefore, assumed great importance in the present day cultivation of farm crops Water hyacinth is a serious pest specially to paddy and also affects irrigation and water transport Important weed killers or herbicides have been developed to eliminate the weeds or field posts so that the growth, vigour and yield of the important economic crops may remain unaffected The experiments of Zimmerman[1,2,3] and his collaborators on plant hormones have shown that certain plant hormones have specific effects in that they can induce cell elongation, modify the pattern on leaves and cause other allied changes proving thereby the herbicidal effects The use of plant hormones such as 2 4 dichlorophenol oxy acetic acid and 2 methyl, 4 chloro phenoxy acetic acid (Methoxone) has gained ground recently in view of their importance to farm crops The present communication describes the action of methoxone on water hyacinth and the extent of changes induced in the plant

COMPARISON OF THE EFFECT OF METHOXONE IN TAP AND POND WATER ON WATER HYACINTH

To determine whether methoxone acts as (i) a plant poison in the sense that when a poison solution is carried upwards with the ascent of sap it kills the entire plant, (ii) a specific hormone by inducing certain changes in the cells leading to the killing of the plant,—a series of experiments in which methoxone had been applied in solution to the roots of the plant, were carried out Methoxone in solution was applied to the roots of the plant growing either in pond water or tap water to determine whether the nature of the water used, has any effect on the degree of response of the plant to methoxone Table I shows the number of petioles showing epinasty in plants growing in tap water and pond water respectively to which 0 1% methoxone has been added Controls were set up without using methoxone

TABLE I

PERCENTAGE NUMBER OF PETIOLES SHOWING EPINASTY

	Tap water		Pond water	
Time in Hours	Control	0 1% Methoxone	Control	0 1% Methoxone
0	0	0	0	0
24	0	39	0	38
48	0	100	0	84
72	4 (showing drooping)			100

It will be seen from Table I that (1) the number of petioles showing epinasty was maximum in 48 to 72 hrs in both tap water and pond water to which 0 1% methoxone had been added The first signs of epinasty were observed within the first 24 hours (2) the petioles affected were coloured slightly reddish by the action of methoxone the changes being most marked in the bases of the petioles , (3) the plants treated with methoxone rotted in 10 to 15 days while in the control no rotting was observed and (4) the action of methoxone was more pronounced in tap water than in pond water

The more pronounced action of methoxone in tap water in comparison with that in pond water, is probably due to the higher concentration of solutes in pond water

(a) The addition of 0 2% salts such as KNO$_3$, NaCl, MgSO$_4$ and 2 0% glucose, prolongs the number of hours required for the appearance of epinasty by the addition of methoxone alone to tap water

(b) The number of petioles showing epinasty in 48 hrs. varies with the nature of salts added (see Table 2).

TABLE 2

The number of hrs. required for epinasty and the percentage number of petioles affected

			Glucose Soln			0.2% KNO$_3$			0.2% NaCl			0.2% Mg SO$_4$		Methoxone	
	Control in Tap Water	2% Glucose Soln.	0.1% Methoxone	1.0% Methoxone	2% KNO$_3$ Soln	0.1% Methoxone	1.0% Methoxone	0.2% NaCl	0.1% Methoxone	1.0% Methoxone	0.2% MgSO$_4$	0.1% Methoxone	1.0% Methoxone	0.1%	1.0%
Time in Hours required for the first appearance of Epinasty	No action	No action	36	24	No action	48	36	No action	47	14	No action	46	41	14	12
Percentage number of petioles showing Epinasty after 48 hrs	0	0	27	91	0	13	70	0	27	38	0	18	61	100	100

It thus appears that the action of methoxone is somewhat inhibited in the presence of salts or sugar in water, in so far as the number of hours required for the first appearance of epinasty and the percentage number of petioles affected vary with the addition of salts. The question whether the semi permeability of the root system or the bases of the petioles which are in contact with methoxone solution is destroyed or killed resulting in the break down of the organisation of the protoplasm, has been examined by studying the effects of (i) the application of methoxone on the root system in water coloured with 0.05% methylene blue, and (ii) application of methoxone as dust on the plant in pond water coloured with 0.05 % methylene blue. Table 3 shows the percentage of number of petioles affected and the rate of diffusion of methylene blue. Controls were set up without using methoxone.

TABLE 3

PERCENTAGE NUMBER OF PETIOLES AFFECTED BY METHOXONE AND RATE OF DIFFUSION OF METHYLENE BLUE

Time in Hours	Control		Treated					
	Pond water + 0.05% methylene blue		0.1% Methoxone + 0.05 % methylene blue		1.0% Methoxone + 0.05% methylene blue		Methoxone dusted on the plant + 0.05% methylene blue	
	Percentage No of petioles affected	Rate of Diffusion	Percentage No of petioles affected	Rate of diffusion	Percentage No of petioles affected	Rate of diffusion	Percentage No of petioles affected	Rate of diffusion
0	0	not marked	0	not marked	0	not marked	0	not marked
24	0		41		53		58	„
48	0		82		95		92	
72	16		94		100		100	„

It will be seen from Table 3 that (i) the application of methoxone either in solution on roots or in the form of spray on plants is effective in so far as epinasty followed by gradual disintegration of the plant until it is completely rotted, and (ii) methylene blue was, however not detected in the cells by microscopic methods.

COMPARISON OF THE EFFECT OF PROTOPLASMIC POISON AND METHOXONE ON WATER HYACINTH

Experiments were carried out to determine how the action of methoxone would differ from the general protoplasmic poisons such as CuSO$_4$ Pb(NO$_3$)$_2$ HgCl$_2$, D.D.T., diphenyl and gammexane on the plant in pond water. It was observed that with CuSO$_4$ and

H_2SO_4 the petioles become flaccid and moribund in 24 hours whereas D D T and gammexane showed no action on the plant $Pb(NO_3)_2$ and $HgCl_2$ caused death to a relatively small number of petioles and methoxone however, affected the majority of the petioles and killed them gradually

EFFECT OF METHOXONE ON THE OSMOTIC VALUE OF THE CELL SAP OF WATER HYACINTH

It is thought necessary to find whether the application of methoxone could induce any change in the osmotic value of the cell sap of the water hyacinth Petioles were cut into segments of (20×5×5) m m size and immersed in varying concentrations of methoxone from 05 to2 0 per cent for one hour and there was a marked increase in the weight of the petioles in most cases However, 0 1 mol to 2 0 mol concentrations of $CuSO_4$ produced a significant decrease in the weight of the segments of petioles On the other hand, with the application of N/5 to N/100 H_2SO_4 resulted in a complete disintegration of the plant tissues

EFFECT OF METHOXONE ON THE RATE OF TRANSPIRATION OF WATER HYACINTH PLANT

In a preliminary expt it was found that as a result of treatment of water hyacinth plant with 1% methoxone, absorption of water was reduced to 79 and 27 per cent when dusted on the plant and the solution was applied to the roots respectively On the other hand, the reduction was brought down to 36 per cent when 1% $CuSO_4$ solution was applied to the roots

The rate of water loss by water hyacinth plant dusted with methoxone shows (Table 4) that the time required for the change of standard cobalt chloride paper is related to the gradual changes induced by methoxone in the plant

TABLE 4

TIME IN MINUTES REQUIRED FOR CHANGES IN THE COBALT CHLORIDE PAPER

Time in Hours	Control		Dusted with Methoxone	
	Upper surface of leaf	Lower surface of leaf	Upper surface of leaf	Lower surface of leaf
0	2 0 mins.	1 5 mins.	2 3 mins	2 2 mins
24	2 0 ,	1 6 ,,	8 3 ,,	6 2 ,,
48	3 0 ,,	3 2 ,,	14 0 ,,	16 2 ,
72	2 5 ,,	2 5 ,,	35 0 ,,	26 0 ,,
120	4 7 ,,	5 7 ,	37 0	34 3
288	2 5 ,,	2 2 ,,	No transpiration	No transpiration

CONCLUSION

The main conclusions reached above concerning the action of methoxone on water hyacinth are

Methoxone can be used as a means of eradication of water hyacinth and it acts specifically on the plant by inducing a sequence of changes both physical and physiological until the plant is completely killed The action of methoxone is somewhat prolonged in the presence of salts or solutes in water and in the same way the use of pond water i e, water of its natural habitat delays somewhat the action of methoxone The action of methoxone is specifically different from that of other plant poisons used such as H_2SO_4, $CuSO_4$, $Pb(NO_3)_2$ in that when the latter are applied on the roots, plants are gradually killed but in the case of methoxone application whether in the form of a solution on the root or in the form of dust on the plant results in the curvature of petioles after a period of 12 to 24 hours followed by a gradual drying and shrivelling of the leaves and the petioles until the whole plant is killed The growing region of the plant is also affected as evident by curvature of this region and this first phase constituting epinasty is presumably due to a symmetrical growth brought about by changes in the plasticity and turgidity of the cell wall, resulting in weight of the petioles From the evidence given above, it is seen that segments of petioles, when immersed in different concentrations of methoxone for an hour, show increase in weight but in the case of $CuSO_4$ and sucrose solution the weight of segments of petioles when immersed in those solutions are constant only at the isotonic points

Methoxone probably acts by changing the osmotic value of the cell sap of the plant as segments of petioles when treated for 72 hrs with methoxone the isotonic point was determined at 0 7 mol sucrose whereas segments of petioles without being treated by methoxone show the isotonic point at 0 4 mol sucrose In the same way the application of methoxone affects the rate of absorption as well as evaporation of water

It was experienced however, that the action of methoxone was transmitted to adjacent petioles even when its application was locally restricted to parts of a single petiole This phenomenon will be better explained if more sensitive methods for the detection of the flow of substance in plant body could be devised

Van Overbeek and Velez have also found that 2 4 di chlorophenoloxy acetic acid destroys the growing point and the intercalary growth regions in *Commelina* and that in *Cyperus*, the well protected growth regions located within the base of the leaf sheaths and 5 cm or more below the leaf surface are decayed In the same way, methoxone has a specific action on the growing points of water hyacinth as well as on the other regions But paddy seedlings are not affected The possibility of application of methoxone on a large scale may be of significant value in fields wherein economic crops are cultivated and threatened by growing water hyacinth plants, and this view has been held by Kar[5] previously

SUMMARY

(i) The action of methoxone, has been studied on water hyacinth plants growing in water of different compositions, (*ii*) The action of methoxone on water hyacinth has been compared to that of other organic and in organic plant poisons and

(*iii*) The changes in the osmotic value of the cell sap of the plant caused by the application of metho xone the effect of methoxone on the rate of absorption of water and the rate of water loss have been studied

We would like to express our deep sense of grati tude to Prof Hla Kyaw for giving us facilities for work to Prof Mg Mg Kha for his suggestions regarding the estimations of epinasty and to the Director Bose Re search Institute and Messrs Imperial Chemical Industries, Ltd Calcutta for the supply of methoxone

REFERENCES

[1] Zimmerman P W and Hitchcock A E *Cont Boyce Thomson Inst* *12* 1 14 & 321 343 194

[2] Zimmerman P W *Ibid* *13* 273 280 1944

[3] Zimmerman P W *Cold Spring Harbour Symposia* *15* 152 1942

[4] Overbeck J V and Velez I *Science* *103* 472 1946

[5] Kar B K SCIENCE AND CULTURE *12* 545 1947

GEOLOGICAL SURVEY OF INDIA*

WE are pleased at the reappearance of the annual publication called the General Report of the Geological Survey of India after a lapse of nearly a decade the last published account of the work of the Geological Survey of India being in *Records Geological Survey of India* 74 Pt 1 1939 40

In course of the last 10 years considerable changes have been effected both in the organisation and methods of work of the Department It needed the impact of the last great war to make India realise the part geologists have to play in peace as well as in war The country was therefore unprepared for the supply to it of suitable personnel in sufficient numbers when the Survey was suddenly called upon to undertake various investigations demanded at the outbreak of the war Under the able guidance of successive Directors how ever the Survey was able to put into the field a large number of young recruits under foreign experts where necessary to carry out the investigations successfully It was however left to Dr W D West the present Director to organise and build up the Department for the larger and long range peace time requirements of India There has been a three fold increase in the gazetted staff of the Department from 27 (including 3 for Burma) in the pre war period to 83 during 1946 47 and of non gazetted staff from 97 to 400 Several specialist sections of Applied Geology have been added to the routine mapping sections Considering that only 18% of the total area of India has been geologically surveyed on the 1" 1 mile scale maps even this three fold increase in officers is nowhere near adequate for completing the survey within a reasonable period of time † The expansion is however to continue and the strength of the gazetted staff will reach the figure 250 with a corresponding addition to the non gazetted side in the near future

The Indian universities are now turning out a sufficient number of graduates in Geology out of whom selections will be made for filling the posts in the Department It will however require the skill of a very experienced administrator to bring about the training of these young recruits and to orientate their acti vities in the right direction It is fortunate that the Geological Survey of India has now at its head Dr W D West the present Director well known for his scholarship and proved administrative ability and one who has been responsible for the planning of the ex pansion of the Department Given sufficient breathing space to try out its new wings we feel confident that the Geological Survey of India augurs well to be one of the leading Geological Surveys of the world under the fostering care of Dr West

In this Report the Director has discussed the functions of a Geological Survey Department and re corded the activities of its different sections Nearly 100 occurrences of 33 industrial rocks and minerals were investigated in various parts of India The Engi neering Geology and Ground Water Resources Section has been equally active judging by the numerous investigations carried out by it for the major dam projects bridge and building sites railway and road alignments multi purpose hydel and storage projects and ground water supply all over India

The newly created Geophysics Section tried out several methods of investigation for locating coal graphite iron ore etc and the experience gained there from would find application in major investigations for hidden mineral deposits in later years

In addition to the Petrological Palaeontological and Chemical Sections a new section of Palaeobotany and the Mineral Information Bureau has been institu ted at Head quarters The journal *Indian Minerals* is published by the Mineral Information Bureau of the Geological Survey of India The Geological Section of the Indian Museum has now been reorganized and the valuable specimens which had been evacuated out of Calcutta for safety during the war years have been restored to the Museum

The Training Camp of the Department imparted field training to 16 newly recruited officers one Lecturer in Geology and eight post graduate students of Indian universities and one Geologist of the C P Government

The report ends with a chapter on the Bibliography of papers dealing with Indian Geology and minerals published during the year 1947

A K G.

---

* General Report of The Geological Survey of India for 1947 *Records Geological Survey of India* *81* Pt. 1 pp 1 240 with 1 Plate (1948) Published by the Government of India, 1949 Price Rs. 4/2 or 6s. 6d

† This aspect of the Survey was referred to by us in our article entitled Hundred years of the Geological Survey of India. (*See* SCIENCE AND CULTURE, *11*, 325, January, 1946) Ed: *Sci. & Cul.*

Notes and News

SYMPOSIUM ON MICROWAVES

A Symposium on Microwaves and allied subjects will be held at Delhi on October 8 9 1949 under the auspices of the Council of Scientific and Industrial Research Prof M N Saha, F R S Chairman, Radio Research Committee, will preside To facilitate discussion 13 Study Groups on the various aspects of Micro waves are being organised under the guidance of scientists as noted below

Microwave Spectroscopy—under Prof S K Mitra, University College of Science Calcutta, *Radio Emission from the Sun*—under Dr H Rakshit, National Physical Laboratory Delhi *Radar Meteorology*—under Dr S K Banerji, Director General of Observatories, India Meteorological Department, New Delhi, *Super refraction*— under Mr M B Sarwate, Director of Communications, Directorate General of Civil Aviation, New Delhi *Microwave Propagation and Electron circuitry*—under Dr N B Bhatt and Mr S K Chatterjee, Indian Institute of Science, Bangalore *Radar in Defence*—under W/Cdr K A Joseph, New Delhi, *Effect of different types of Obstacles on Microwave Propagation*—under Dr S S Banerjee, Engineering Department, Banaras Hindu University *Semi conductors and Crystals*—under Dr K R Dixit, Professor of Physics, Royal Institute of Science, Bombay, *Microwave Dielectrics* —under Prof P C Mahanti, University College of Science, Calcutta *Nuclear Studies with Microwaves*—under the Director Institute of Nuclear Physics, Calcutta, *Thermal and Fluctuation Noise* —under Dr D S Kothari, Scientific Adviser, Ministry of Defence, New Delhi *Application of Microwaves in Television and Broadcasting*—under Mr B V Baliga, Chief Engineer, All India Radio, New Delhi, *Frequency Modulation*—under Mr S P Ghosh, Special Officer, Wireless, Government of West Bengal, Calcutta

A Steering Committee to make arrangements for the Symposium has also been constituted This Committee will make a preliminary scrutiny of the various papers submitted through the Study Groups for presentation at the Symposium To the Symposium will be invited the contributors of papers

An exhibition of radar and microwave equipment would also be held at New Delhi along with this Symposium on the above mentioned dates Scientists desirous of taking part in the Symposium may communicate with the heads of the Study Groups shown above or write to Prof M N Saha

IMPROVED METHODS FOR ISOLATING THORIUM

Improved methods of extracting thorium, a potential source of atomic energy, from monazite sands in which it is found, have been evolved by three analytical chemists, Dr Louis Gordon, of Syracuse University, New York, C H Vanselow, a Syracuse student, and Prof H H Willard, of Michigan University, U S A

Many of the recent investigations on thorium's atomic energy possibilities, have been directed toward determining the thorium content of monazite sand accurately According to Dr Gordon, upto now most of their procedures for separating the element from monazite yielded thorium compounds which were extremely difficult to handle They were particularly hard to separate from an accompanying liquid containing impurities The chemists reported that the gelatinous and very slimy product both clogged the filter machanism and also retained considerable impurities within its voluminous confines The new separation methods developed by these chemists for analytical purposes produce a granular material similar to ordinary table salt

Thorium itself cannot serve as a nuclear fuel, but it can be converted in the atomic pile into an isotope of uranium called U 233 which like Uranium 235 is fissionable (*The Chemical Age*, July 9, 1949)

RESEARCH ON CANCER

Cancer research has recently made some definite progress in the early diagnosis and effective treatment of the disease One striking development has been announced by George W Kidder and his co workers of Amherst College, who have discovered a clear cut metabolic difference between cancerous and normal mammalian tissue The difference lies in the cells' use of guanine, a substance entering into the formation of nucleic acid Malignant cells require guanine, normal cells do not

The finding was applied in a significant experiment A cancerous mouse was fed a diet including pseudoguanine a metabolically useless compound which resembles guanine so closely that cells take it up as if it were guanine itself This antimetabolite did not kill the mouse cancer, but it stopped tumour growth And growth resumed as soon as administration of the drug ceased Although pseudoguanine may be toxic to normal as well as malignant cells, the technique represents an approach that may yield results in the future

Another approach to the problem of curbing the growth of malignant tumours is reported by Henry K Wachtel of Fordham University Wachtel has extracted a fatty substance from fresh cattle pituitary glands which inhibits the growth of soft tissue cancers in experimental animals In some cases the cancer regressed partly or completely. The pituitary substance also produces a definite effect in the blood reducing the level of the fatlike compound cholesterol. The identification of the substance awaits its preparation in large quantities.

Three significant advances have also been made in the diagnosis of cancer. S. A. Gladstone of the New York Polyclinic Hospital has developed a simple sponge technique for recovering specimen cells from various body surfaces and cavities. The sponge, which is made of gelatin, is rubbed over areas from which specimens are desired. Enough cells adhere to the gelatin to provide material for microscopic study. The technique is being tested by hospitals in several cities and has been employed in more than 700 cases, including cancers of the cervix, uterus, rectum, mouth, pharynx, oesophagus and lung. It is said to be at least as reliable as biopsy, the surgical removal of a tissue sample which is a standard practice in diagnosing cancer. The sponge method may also aid in the diagnosis of gastric cancer, the most difficult form of cancer to detect. The gelatin can readily be inserted into the stomach through a tube.

Another test, for the examination of patients who may have cancer of the cervix or uterus, has been devised by Harold S. Burr of Yale University and Louis Langman of New York's Bellevue Hospital. It is based on the electrical characteristics of living tissue. Contacts placed on the abdomen and in the vagina pick up a negative potential in non pregnant women with no uterine or cervical pathology. A positive potential is observed in pregnant women and those with cancer or certain other disorders of the genital tract. Erroneous diagnoses were made in only 15 per cent of the tests.

Charles Huggins of the University of Chicago has reported a test for cancer that involves the analysis of blood. Iodoacetic acid inhibits the coagulation of proteins in heated blood serum, and it takes less iodoacetic acid to inhibit coagulation in the serum of a person with cancer. This difference is the basis of the test. Although false positive reactions are obtained in pulmonary tuberculosis and acute infections, these conditions may be easily distinguished from cancer. The test, which provides no information as to the site of the growth, has been checked on 300 persons. Huggins has described it as "not quite as good as the Wassermann test" for syphilis. Blood tests for cancer have been reported on four previous occasions, but until now have proved unreliable. (*Scientific American*, June 1949)

STREPTOMYCIN AND PAS FOR TUBERCULOSIS

The recent Second Commonwealth and Empire Health and Tuberculosis Conference, in London, sponsored by the National Association for the Prevention of Tuberculosis, afforded some new light on "Trends in the Modern Treatment of Tuberculosis, including Streptomycin and PAS." Dr. Geoffrey Marshall, of Guy's and Brompton Hospitals, reported that streptomycin was a treatment of great value but with unfortunate limitations. He mentioned the Medical Research Council's trial of streptomycin, which had been carried out with scientific controls of a stricter order than ever before in the trial of any treatment for tuberculosis. Streptomycin had achieved wonderful results in tuberculous meningitis—complete recovery in 40 per cent of cases, whereas before, the death rate was almost 100 per cent.

In pulmonary cases, said Dr. Marshall, streptomycin was only useful for a short time, and only once for any one patient, owing to the development of streptomycin resistant bacillus, but it could be an adjunct to other treatment if its limitations were realised. "Do not use streptomycin because it may be good for a patient, but only when it is indispensable."

Professor Lehmann, of Gothenburg, gave a description of work in Sweden with PAS (para amino salicylic acid) a new drug which is now on trial in England. One of the values of this drug, he said, was that it could be given in large quantities for long periods of time. A report on a group of 205 pulmonary cases showed that, in the majority of them, progressive pulmonary tuberculosis had been converted into a healing phase. Intestinal tuberculosis cases had, said Prof. Lehmann, given perhaps the most satisfactory results with PAS treatment—19 out of 20 showed definite improvement—and in 70 per cent of urogenital cases the bacilli disappeared within a year. Possibly, combined treatment, *i.e.*, with streptomycin, might be the most successful in the end, and these drugs could not be considered as a substitute for other methods. (*The Chemical Age*, July 23, 1949.)

GALLIUM ISOTOPE FOR BONE CANCER

Radiogallium can be used in the treatment of bone cancer, said H. C. Dudley of the U. S. Navy Medical Science Corps. The radioisotope has been tested on mice and dogs, and the Atomic Energy Commission recently approved its use on selected human cancer patients at U. S. Naval Hospital, Bethesda, Md.

The radioactive metal, gallium 72, is processed into radiogallium lactate, a chemical form suitable for injection. Co operation of the National Cancer Institute with the Navy resulted in the discovery that radiogallium concentrates at diseased portions of bone. (*Chemical and Engineering News*, June 20, 1949.)

SURVEY OF THE SKY

A four year survey of the sky will begin from July 1 at Palomar Observatory, under the joint sponsorship of the National Geographic Society and the California Institute of Technology. The aim of the project is to provide a comprehensive sky atlas, for use primarily in selecting areas and objects for intensive study with more powerful telescopes.

Palomar's 48 inch Schmidt telescope, which will be used for the photomapping, has already been in operation for two or three years piling up work for the observatory's new 200 inch telescope The Schmidt's wide angle lens which can focus on a single 14 × 14 inch plate a swathe of sky equal to a dozen diameters of our moon will scan the sky in broad quadrangles Identical exposures through blue and red filters will be made for each area Palomar astronomers expect to obtain no more than four pairs of matching red and blue plates in a single night, even under ideal weather conditions A blue exposure takes 30 minutes a red, about an hour

Three fourths of the heavens can be reached from Palomar with high accuracy an additional ten per cent can be covered in some degree A supplementary survey of the remainder will be made after the four year study is completed The Palomar survey will record some five hundred million stars and perhaps ten million complete stellar systems of extragalactic nebulae The resultant sky atlas, equivalent in size to 20 large volumes will comprise reproductions of more than 2 000 overlapping plates

The Schmidt telescope invented in 1930 by Bernhard Schmidt was the most significant advance in astronomical instruments for several decades Parabolic reflectors like the 200 inch at Palomar have a very small field only a fraction of a degree and of that small field only a small area in the center is well defined Schmidt discovered how to get sharp definition at low focal ratios He did this by interposing at the center of curvature of a spherical mirror a thin correcting plate, deformed so as to parabolize the sphere By this means, light rays, first refracted by the correcting lens and then reflected from the mirror focus uniformly on the photographic plate For speed and convenience the Schmidt camera serves as the miniature camera of astronomy (*Science*, June 24, 1949)

A NEW GROUP OF PLANT GROWTH REGULATORS

O L Haffmann and A E Smith of U S Rubber Company Connecticut announce that a new group of plant growth regulating chemicals, the N aryl phthalamic acids have been discovered These compounds are readily prepared from phthalic anhydride and aromatic amines The esters, amides, and soluble salts of these acids as well as the N aryl phthalimides (II) have been found to possess similar activity

The nature and degree of the growth response shown by plants treated with these chemicals depend on the type and age of the plant and on the concentration and identity of the phthalamic acid derivative used

It will be seen that the active concentrations of different compounds vary greatly A general pattern of response however is evident At low concentrations fruit set is stimulated and seedless tomatoes are often produced A morphological response involving broadening of the leaves is usually evident (*Science*, June 10, 1949, *109*, p 588)

EQUINE PREGNANCY DIAGNOSIS BY BIOLOGICAL AND CHEMICAL TECHNIQUES

Equine pregnancy has been determined by several biological and chemical methods the former depending on the early presence of gonadotropin in the blood, the latter depending on the later appearance of estrogen in the urine

A pregnancy survey involving 119 mares was based on diagnosis by biological testing of serum or by chemical examination of urine Some mares were tested by both methods Collections were made at the optimum stage of pregnancy for each method and foaling records were used to determine the reliability of the methods

All positive diagnoses were confirmed Incorrect negative diagnoses by biological and chemical methods were made in 8 5 and 7 3 per cent of the tests respectively

Mares which were examined by both methods gave identical responses for each test

While biological procedure provides an early diagnostic test, the chemical procedure, because of its economy, simplicity and comparative reliability, is preferred for pregnancy confirmation (*Scientific Agriculture* June 29 1949, pp 302 304)

EFFECT OF AGE OF PLANT AND RETTING PROCEDURES ON KENAF (*HIBISCUS CANNABINUS* L) FIBRE

A L Burkett, E D Gordon, V C Pettit, O A Pope, J E Walker and J B Acuna report that they compared four methods of retting as means of producing fibres from kenaf (*H cannabinus*)

Two of these methods were concerned with standing plants In the first of these, attempts were made to kill the growing plants by dusting with aero cyanamid, spraying with 2,4 D solutions, and spraying with kerosene None of the three methods was satisfactory The cyanamid dusting and kerosene sprays failed to kill the plants with satisfactory consistency The 2, 4 D not only failed to kill the plants, but induced the formation of numerous adventitious root-like growths along the stems The fibre from the plants on the artificial kele plots remained in tight ribbon like strands which were unsuitable for use as fibre

The portion of the study concerned with a standing field ret of plants allowed to die naturally did not produce satisfactory fibre The plants died very unevenly and this resulted in serious deterioration in observed fibre strength on those plants dying earliest

Drip retting which has shown promise as a method of retting hemp in the United States, was found to be unsatisfactory with kenaf from the standpoint of fibre quality

Field retting of cut plants produced more satisfactory fibre than any of the other three methods used in this study, although the quality of fibre was in general not as good as that produced by mechanical decortication

Results of study show that field retting takes place more rapidly during the rainy season than during the dry season

The youngest plants included in the study, 63 days of age, retted more rapidly than older plants the difference being especially marked in the dry season

The percentage of retted stalks was found to increase in close proportion to the time of exposure

Turning of stalks in the field was found to increase the speed of retting particularly on plants 84 and 105 days of age Little effect of turning was evident on the 63 day old plants, probably due to the fact that the high moisture content of plants largely supplied the moisture required in retting The rate of retting on the 126 day old plants was comparatively slow, especially in the dry season ret and turning had no consistent effect on rate (*Agronomy Journal 41* June 1949, pp 255 260)

INSTITUTE OF MICROBIOLOGY

A gift of $1,000,000 to establish an Institute of Microbiology has been given to Rutgers University by Selman A Waksman Rutgers alumnus and faculty member for 25 years Dr Waksman, who discovered *Streptomycin*, has assigned his patent to the Rutgers Research and Endowment Foundation Royalties will be used to build and operate the new institution and Dr Waksman will be its first Director (*Science* May 20, 1949, *109* p 526)

NEW PLANT RESEARCH LABORATORY

California Institute of Technology dedicated its new $407,000 Earhart Plant Research Laboratory on June 7 Frits Went, Professor of Plant Physiology in the Biology Division is the Director of the Laboratory

By control of the temperature, humidity, light and gas content of the air within the laboratory, a wide range of climatic conditions will be stimulated to study their effects on plant growth All green houses are equipped with de ionised water and compressed air and are kept sterile A prefocussed camera, containing enough film for eight hundred pictures, will photograph plants at desired intervals Time will be recorded in centi days—periods of 14 minutes and 24 seconds each. Clocks are so placed that they will appear in each photograph and record the exact time of exposure Research at the laboratory is aimed at matching plants to climate for better crop production (*Science*, June 17, 1949, *109*, pp 618 619)

PLASMODESMATA IN XYLEM VESSELS

F M Scott of the Dept of Botany, University of California U S A writes that plasmodesmata have not been demonstrated in xylem vessels previously She however, observes that cell walls are heterogenous perforate structures the pores of which are filled with living protoplasmic strands presumably capable of active metabolism Further investigation is required in order to determine whether the pattern of living xylem as described is repeated generally in other vascular plants or whether, as seems hardly probable, it is confined to the three species mentioned, *Acanthus mollis Echinocystis macrocarpa* and *Vicia faba* (*Botanical Gazette, 110* March 1949, pp 492 495)

JAY KISSEN MOOKERJEE MEDAL

Dr Arthur E Morgan, first president of the Tennessee Valley Authority, was awarded the Jay Kissen Mookerjee gold medal of the Indian Association for the Cultivation of Science at a ceremony held at the Association on August 27 1949 Prof M N Saha, President of the Association, presented the medal before a distinguished gathering of engineers scientists and members

In course of an interesting lecture on Modern Trends in Engineering Education Dr Morgan briefly narrated the history of the development of engineering education as a professional education in Western Europe and in the U S A He said that modern engineering education should be so planned that students were not only imparted knowledge of engineering subjects as accurately and fully as possible, but also taught how to be a good citizen of the country The social function of the engineers according to him, should form the most important part of engineering education Dr Morgan stressed the necessity of imparting practical knowledge and of developing the habit of working side by side with technicians and labourers during the early training along with theoretical lessons in the class room This method is widely practised in the American engineering institutions, and students are generally engaged in part time jobs, often in important engineering projects during their student career He cited the example of a student who was given the very important and responsible position of an assistant engineer in connection with a big air field construction in the U S A

Dr Morgan suggested that engineering institution should design courses according to individual tastes and interest of the students instead of planning a common course for them He further said that students in India taking an engineering course should not only be satisfied with the old routine curriculum, but should work around to see which branches of engineering would be most useful to India and which would suit these best They should decide and concentrate on those particular branches and the engineering colleges should make the necessary provision for such studies According to him India's need was not for mass production of engineers, but for engineers specializing in particular branches of engineering Furthermore they should not only be technicians, but men with a sound knowledge of the social and economic conditions in the country

PROFESSOR PAUL KARRER

The 60th birthday of Professor Paul Karrer, N L, one of the outstanding figures in the domain of Organic Chemistry and Director of the Chemical Institute of the University of Zurich was celebrated on April 21, 1949 On this memorable occasion his students, friends and colleagues have presented him with a Festschrift (Festive publication) which embodies a large number of original papers on diverse chemical topics These papers have been contributed by the front rank scientists of every nationality and as such the Festschrift stands as a valuable book of reference An interesting feature of the book is that in the very first article we find the name of an Indian worker Sri T R Govindachari who in collaboration with Dr Roger Adams has contributed a paper on *Senecio* alkaloids The name of another Indian worker, Srijukta D Mukherji occurs in connection with the investigations on Ajmaline from the Dyson Perrins Laboratory Oxford University which has been reported by Sir Robert Robinson The work on Ajmaline has appeared under the joint names of D Mukherji, R Robinson and E Schlitter

We wish Professor Karrer many years of active and happy life which may offer him opportunities for advancing human knowledge and well-being of his fellow men

ANNOUNCEMENTS

Dr J N Mukherjee Director, Indian Agricultural Research Institute New Delhi will attend the meeting of the General Assembly of the International Council of Scientific Unions to be held at Copenhagen from September 14 16 1949

Sri P C Sen Choudhuri has been awarded an I C I (India) Research Fellowship of the National Institute of Sciences of India to work on the existence of a new type of penetrating radiation inferred from some anomalies observed in the absorption of gamma-photons from RaC under the guidance of Dr D M Bose at Bose Research Institute Calcutta

Dr N N Das Lecturer in Physiology University College of Science and Technology, Calcutta, has been awarded a Ghosh Travelling Fellowship of the Calcutta University to have an advanced study on neuro physiology specially in relation to Electroencephalography, a subject which has not as yet received due attention in this country A former Research Fellow of the late Sir J C Bose for a decade at the early part of his life and later a research worker in the School of Tropical Medicine under Sir Ramnath Chopra, Dr Das investigated Pharmacological and Physiological problems by introducing tissue culture technique He recorded action current from nerves and potential changes in the brain by building up an Oscillograph of his own design He also conducted researches on Virus and contributed some valuable information regarding the treatment of Small Pox and Typhus During the last war Dr Das was Assistant Professor of Pathology in the School of Tropical Medicine, Calcutta

---

> *It was when I came upon the mute witness of these self made records and perceived in them one phase of a pervading unity that bears within it all things the mote that quivers in ripples of light, the teeming life upon earth, and the radiant suns that shine above us—it was then that I understood for the first time a little of that message proclaimed by my ancestors on the banks of the Ganges thirty centuries ago*
>
> *'They who see but one in all the changing manifestations of this universe*
> *unto them belongs Eternal Truth—unto none else, unto none else'"*

—Extract from Acharya Jagadish Chandra Bose's speech before the Royal Institution, London, 1915

LETTERS TO THE EDITOR

[The Editors are not responsible for the views expressed in the letters]

ON THE AFFINITIES OF MORINGACEAE

I

Chatterjee[1] writes, The family *Violaceae* like some other families, such as, *Polygalaceae Bignoniaceae*, *Melianthaceae* etc have been mentioned as affording some characters for comparison with *Moringaceae* (Engl Pflanzenfam *17B* 696, 1936), but in view of several other characters, none was bold enough to suggest that *Moringaceae* should be taken out of the orders *Rhoeadales* or *Capparidales* This has now been proposed by Datta and Mitra While fully admitting that such discussion on problems of phylogeny may not lead us anywhere outside the field of speculaton, it may be still profitable to point out certain objections to this proposed change

In our paper, it was clearly stated from a quotation of Hooker that *Moringaceae* was previously placed near *Violaceae* by some earlier observers as well as near *Polygalaceae*, *Bignoniaceae**, *Melianthaceae*, *Resedaceae* etc Le Maout and Decaisne[4], though they hold the view that *Moringaceae* is nearly related to *Capparidaceae*, writes, Hooker (following Lindley) compared it to *Violarieae* which it resembles in their irregular flower with unequal dorsal petal, in their perigynous insertion, tubular style, one celled ovary with three parietal nerviform placentas and anatropous ovules ''

So, it is clearly evident that some earlier workers also came to the same conclusions as that of ours, on some other adequate reasonings so as to place *Moringaceae* near *Violaceae* We also clearly recorded and discussed the similarities and dissimilarities between these two families But, so far none had mentioned or taken into consideration as an additional proof or showed the similarities of the pollen morphology, although the pollen morphology is now a days considered to be of great phylogenetic significance

Inclusion of *Moringaceae* under the *Rhoeadales* has long been challenged and disputed previously We separated the said family from Hutchinson's new order *Capparidales* to place the same near *Violaceae* on adequate and sound reasonings given in our paper If the aid of anatomical characters *e g*, the presence of Myrosine cells in certain families, be sought for in a phylogenetic system of classification, we see no reason why the pollen morphology, should be totally ignored

We frankly admit we could not procure Jumelle's work at Dacca (East Pakistan) in 1947, and we failed to refer to it But Jumelle, as well as Hutchinson, both have emphasized the close association of *Moringaceae* with *Capparidaceae*—a view not accepted by us Even Engler and Prantl did not accept the self same view of Jumelle in 1936, who did not consider the pollen morphology at all

Chatterjee further emphasizes Apparently Jumelle overlooked the characters of the remarkable family *Bretschneideraceae* from Yunnan, China, which should have been considered by him in this connection In *Bretschneidera sinensis* Hemsley (see fig in Engl Pflanzenfam 17*B* 700, 1936) we find a combination of characters between *Moringaceae* and *Capparidaceae*, and *Bretschneideraceae* should be regarded as something like a link between these two families This would further strengthen Jumelle's view

But Hutchinson[3], included the families *Hippocastanaceae* and *Bretschneideraceae* within the family *Sapindaceae* under his order No 57 *Sapindales* (p *252*) We regret to note that none of these authors mentioned any thing at all regarding the pollen morphology of this remarkable family Other characters of *Moringaceae* and *Violaceae* are as follows *Moringaceae* have not got *homochlamydeous* perianth, it is *heterochlamydeous* (*Cf* Engler and Diels, *Syllabus*, 221, 1936)[2] Further, *loculicidal capsular fruit* also occurs in *Violaceae* (*Cf* Rendle[5]) The genus *Rinorea* (= *Alsodeia*) (Fam *Violaceae*) contains 60 species of trees and shrubs in the tropics In the climbing genera *Anchieta* and *Agatea* (Fam *Violaceae*) the seeds are winged

We also carefully went through Chatterjee's opinion expressed in his para 2 If *Moringaceae* be not phylogenetically related to *Capparidaceae* at all, is it wrong to transfer the same from the order *Capparidales* ? Chatterjee himself brought the family *Bretschneideraceae* by separating it from *Sapindaceae* of Hutchinson's *Sapindales* to serve as a link between *Capparidaceae* and *Moringaceae*

Conceding that the *Capparidales* is an end point, does this not arise from the *Rhoeadales plexus* of Hutchinson now? If so, the *Violales* is also near the *Capparidales*, though on different lines in the evolutionary series as previously proposed by Hutchinson How far the theory of arborescent *versus* herbaceous origin is tenable remains to be observed with the rapid progress of our knowledge in different fields of Botany

R M DATTA

Jute Agricultural Research Institute,
Indian Central Jute Committee, Hooghly

J N MITRA

Department of Botany, Presidency College,
Calcutta, 20 1-1949

---

*Probably it would be *Begoniaceae* as *Bignoniaceae* belongs to the group *Sympetalae*. Ed: *Sci. & Cul.*

[1] Chatterjee, D SCIENCE AND CULTURE, *14*, 253 254, 1948

[2] Engler, A and L Diels. Syllabus der Pflanzenfamilien, 221, 1936

[3] Hutchinson, J Families of Flowering plants, I, 1936

[4] Le Maout, Emm and J Decaisne, A general system of Botany, descriptive and analytical Translated by Mrs. Hooker 235 236, 1873

[5] Rendle, A B The classification of flowering plants. II., 208, 1925.

II

In my earlier note[1], I have discussed the subject in some detail and have pointed out that there are some significant characters such as myrosine cells and gynophore, present in both *Capparidaceae* and *Moringaceae*. These with certain other characters suggest an affinity between these two families. Datta and Mitra have preferred to stress more on the characters of the pollen grains, and have suggested on the other hand, that *Moringaceae* has a stronger alliance with *Violaceae*. It has been generally found convenient to correlate characters like that of pollen grains, with some other morphological characters. This has been done with advantage in such closely related genera like *Gutzlaffia* and *Phlebophyllum* of *Acanthaceae*. However, if Datta and Mitra still consider that only the pollen morphology is essential for deciding phylogenetic relationship, and on this basis the family *Moringaceae* has stronger relationship with *Violaceae* they are entitled to hold their views.

It has been admitted by Datta and Mitra that they were unable to consult Jumelle's work referred in my previous note. It is also clearly evident that they did not consult *Pflanzenfamilien 17B* (1936) where the family *Bretschneideraceae* has been placed in between *Capparidaceae* and *Moringaceae*. This separation of *Bretschneideraceae* from its older alliance with *Sapindaceae* is now justified after the recent discovery of the fruit of *Bretschneidera sinensis* Hemsley by Handel Mazzetti. From all these and other considerations there is no doubt that Datta and Mitra have worked under some handicaps at Dacca.

In the absence of any stronger and significant character, the family *Moringaceae* should still be associated with *Capparidaceae*, and both should remain in the order *Capparidales* *

D. CHATTERJEE

Division of Botany,
Indian Agricultural Research
Institute, New Delhi
13.7.1949

---

[1] SCIENCE AND CULTURE 14, 253, 1948

[*_This correspondence is closed. Ed. *Sci. & Cul.*]

BEAT THEORY OF PERIODIC FADING OF SHORT WAVE RADIO SINGALS DUE TO DOPPLER EFFECT IN MOVING IONOSPHERIC LAYERS

Appleton and Bynon[1] have shown that periodic patterns of fading of radio signals on short waves can be caused by the interference between the magneto ionic components of the radio wave under suitable conditions. The conditions are (i) the electron density of the ionospheric layer should steadily decrease or increase, and (ii) the electron density of the layer should be comparatively low so as to be just enough for single reflexion between the transmitting and receiving stations. The first condition prevails during the time of sunset in the evening or during sunrise in the early morning. The second condition requires that the operating frequency should be in the neighbourhood of the maximum usable frequency for the distance between the transmitting and receiving stations.

If the electron density of the ionospheric layer is large so that its M.U.F. value is correspondingly high and exceeds the frequency of the radio signal by a considerable amount, the periodic fading due to the interference between the ordinary and extra ordinary components will be much too slow to be discernible in the fading records. The possibility of a periodic fading of a different origin under such conditions of high electron density has recently been reported by Banerjee and Mukerjee[2,3] and by Banerjee and Singh[4,5]. They have observed periodic patterns when the ionospheric ionization is relatively high and the observed periodicity has been attributed to the interference between the two waves singly and doubly reflected from the same layer or between the singly reflected waves from the two different layers when one or both possess a vertical movement. Any such vertical movement would produce a continuous change in the path difference of the two interfering waves and give rise to intensity maxima and minima with a periodicity depending upon the rate of movement. A periodic type of fading is accordingly expected during the time of sunset and sunrise when there is a slow vertical movement of the ionospheric layers.

The object of the present communication is to propose a different theory as to the origin of the periodic fading pattern observed in the early morning or evening hours, when the frequency of the signal is very much less than the M.U.F. value for either E or F layer and there is no possibility of the Appleton Beynon type of periodic fading. If conditions are such that simultaneous single and double reflexions from the same E or F layer are possible it is evident that the singly and doubly reflected waves from the same moving layer will suffer different amounts of Doppler change of frequency as they proceed towards the receiving station from distinctly different directions. Thus there will be a difference in the frequencies of the singly and doubly reflected waves from the same moving layer. A similar difference in frequency is also expected in the case of simultaneous single reflexions from both E and F layers, when both the layers have a vertical movement. In either case, the two interfering waves of slightly different frequencies would necessarily give a resultant beat note with a progressively increasing amplitude followed by a corresponding decrease in amplitude in a periodic manner. When this beat note is received by the receiver, the output after rectification in the detector stage would constitute the envelope of such resultant beat note with one side wiped out. This would be similar in appearance to a slow rythmic fading the periodicity of which would correspond to the difference in the frequencies of the down coming waves as determined by the Döppler formula (Fig. 1)

Let us first consider the case when the singly and doubly reflected waves from the same layer proceed towards the receiving point It is to be noted that a singly reflected wave suffers a Döppler change of frequency once and a doubly reflected wave twice

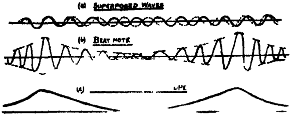


Fig 1

If the angles of incidence corresponding to the singly and doubly reflected waves from the same layer moving with a velocity v in the vertical direction are denoted by θ_1 and θ_2 respectively, then the difference in frequency Δf between the two interfering waves is given by

$$\frac{\Delta f}{f} = \frac{2v}{c} (2 \operatorname{Cos} \theta_2 - \operatorname{Cos} \theta_1)$$

The periodicity n which is the same as Δf is then obtained from

$$n = \frac{2v}{\lambda} (2 \operatorname{Cos} \theta_2 - \operatorname{Cos} \theta_1) \tag{1}$$

where the frequency f is replaced by the wave length λ Similarly in the case of the singly reflected waves from the two layers moving with the same velocity v the periodicity due to the Doppler effect is given by

$$n = \frac{2v}{\lambda} (\operatorname{Cos} \phi_1 - \operatorname{Cos} \theta_1) \tag{2}$$

where θ_1 and ϕ_1 are the angles of incidence at the E and F layers respectively for simultaneous single reflexions

For the sake of comparison, we give below the expressions for periodicity as expected from the theory of Banerjee and his colleagues Using the same notations, the periodicity in the case of the singly and doubly reflected waves from the same moving layer is given by

$$n = \frac{2v}{\lambda} \left(\frac{2}{\operatorname{Cos} \theta_2} - \frac{1}{\operatorname{Cos} \theta_1} \right) \tag{3}$$

Similarly the periodicity in the case of the singly reflected waves from the E and F layers both of which are moving is obtained from

$$n = \frac{2v}{\lambda} \left(\frac{1}{\operatorname{Cos} \phi_1} - \frac{1}{\operatorname{Cos} \theta_1} \right) \tag{4}$$

Considering the signals from Delhi received at Banaras (distance 678 Km) and taking the E and F_2 layer heights to be 100 Km and 360 Km respectively, the Döppler beat formula (1) in the case of the singly and doubly reflected waves from the F_2 region becomes

$$n \simeq \frac{2\ 2v}{\lambda} \tag{1a}$$

Similarly the Doppler beat formula (2) for the singly reflected waves from both E and F_2 regions is reduced to

$$n \simeq \frac{9v}{\lambda} \tag{2a}$$

The corresponding formulæ according to Banerjee and his colleagues are

$$n \simeq \frac{1\ 6v}{\lambda} \quad \text{(Single and double reflexions) from the } F_2 \text{ region} \tag{3a}$$

$$\text{and } n \simeq \frac{5\ 6v}{\lambda} \quad \text{(Single reflexions from) both layers} \tag{4a}$$

With regard to the periodic fading observations by Banerjee and his colleagues at Banaras on 25 or 19 metres bands from Delhi, it appears that the slow fading with a periodicity of 1 to 5 cycles per minute observed with the singly and doubly reflected waves from the F_2 region cannot be explained by the formula (3a) according to which the periodicity of fading should be about 14 cycles per min if the vertical drift of the ionospheric layer is taken as 3 metres/sec (i e , about 11 Km per hour) For the same value of the vertical drift of the layer, the Döppler beat formula (1a) would also give a higher periodicity (about 20 cycles/min) It is likely that the observed slow periodic fading was of magneto ionic origin With relatively high electron density of the layer, the M U F —value (for transmission between Delhi and Banaras *via* the F layer) may lie in the neighbourhood of the frequency of the signals The Appleton Beynon type of periodic fading is therefore possible on these frequencies in the morning and evening hours, and the observed small order of periodicity may be caused by the interference between the upper and lower ordinary ray, if the frequency of the signal happens to be only slightly less than the M U F value for the F layer In interpreting their fading pattern where quick periodic ripples were found superposed on a slow periodic variation, Banerjee and his colleagues have also associated the slow periodicity with magneto-ionic splitting The superposed ripples have, however, been attributed to the vertical movement of the ionospheric layer

In conclusion a reference should be made of our recent investigation carried out at Dacca on periodic fading employing Calcutta signals of 4840 Kc /s The results of the investigation which will be published elsewhere appear to be in better accord with the proposed Döppler beat theory

S R KHASTGIR

Banaras Hindu University
Banaras 20 5 1949

---

[1] E V Appleton & W J G Beynon *Proc Phys Soc* (Lond) *58 59* 1947
[2] S S Banerjee & G C Mukerjee *Science & Culture 11* 571 1949
[3] S S Banerjee & G C Mukerjee *Phil Mag* Ser *7* 39 697 1948
[4] S S Banerjee & R N Singh *Ind Jour Physics 22* No 9 413 1948
[5] S S Banerjee & R N Singh *Science & Culture 14* 293 1949

VERTICAL DISTRIBUTION OF ATMOSPHERIC OZONE IN LOW LATITUDES

In the last issue of the *Proceedings of the Indian Academy of Sciences* (*29* 330 1949) Karandikar and Ramanathan have given the result of their ozone measurements in India and in conjunction with the results of workers elsewhere have given some concluding remarks (p 345) There is likely to be some misunderstanding if the question is not stated fully

In the Bakerian lecture of the Royal Society delivered in 1945 and published in Feb 1946 (and in a lecture by the senior author before the Royal Aeronautical Society in Dec 1945 and printed in *Aeroplane* of Jan 4 1946) Dobson and his collaborators showed that by varying the quantity of ozone and water vapour in a given cubic content of air at higher levels the effect of radiation balance would lead to differing temperatures of the tropopause or the base of the stratosphere By increasing the amount of water vapour and decreasing the amount of ozone the tropopause temperature was shown to diminish and this observation provided a clue to the low temperature of the equatorial tropopause The extract from their conclusions

> (b) Because for reasons that are not yet fully known the amount of ozone and probably the ratio of ozone to water vapour is greater over the polar regions than over the equator
>
> (c) Because the temperature lapse due to turbulent mixing of the air has to extend to a greater height before the temperature is reached at which the air is in radiative equilibrium

By a study of synoptic charts they also showed that in the warm sector of the extra tropical cyclones (in the tropical air mass) the amount of ozone was found to be less than in the cold sector In the issue of *Aeroplane* referred to above the difficulty of accounting for the change in the ratio was more categorically mentioned

The author was able to answer partially the difficulty mentioned by Dobson[1] as a subsidiary deduction, at the symposium of the National Institute of Sciences of India held at Bombay in August September, 1946

In a discussion of sounding balloon results,[3] Ramanathan had suggested alternatives for the greater height of the equatorial tropopause without giving any preference to either of them Though the laboratory evidence regarding the photolysis of ozone in the presence of water vapour was conflicting in the twenties of this century Forbes and Heidt[4] in 1934 had definitely measured the magnitudes involved Dobson and his co workers found that with their new hygrometer the amount of ozone at higher levels was only 1/50 of the amount previously believed The question of application of photolysis of ozone in presence of water vapour to the atmosphere could only arise when it was pointed out that the ratio of ozone to water vapour was a vital factor in the tropopause temperature by Dobson *et al* The present writer picked from Ramanathan s previous work the relevant cause for a higher tropopause which was consistent with (c) of Dobson *et al* and stated categorically that it was not necessary to import any fresh cause for the photolysis of ozone than the extra water vapour itself and pointed out that the equilibrium components would be ozone, water vapour and ultra violet light The suggestion of lesser ozone in the tropical air as similar was given due to lack of complete knowledge of speed of reaction

In the paper by Karandikar and Ramanathan, the authors make the same statements as made by Dobson in (b) and about the reduction of ozone in the atmosphere by photolysis in presence of water vapour as by the present writer with scarcely any previous references apart from quoting the laboratory experiments of Fwell[5] in 1942 As the application to the atmosphere by Karandikar and Ramanathan consists of only analogies from the laboratory experiments it appears strange that references to earlier papers and suggestions have been cut out The present writer has not been able to communicate yet the detailed analysis due to other preoccupations

S L MALURKAR

Colaba and Alibag Observatories,
Bombay 6 6 1949

---

[1] Dobson Brewer and Cwilong Meteorology of the Lower Atmosphere *Proc. Roy Soc.* (Lond) *185* 144 1946
[2] Malurkar Why Less Ozone over Equatorial Latitudes *Curr Sci 15* 280 1946
[3] Ramanathan *Mem Ind Met Dept 25* 183 1930
[4] Forbes and Heidt The Influence of water upon the photolysis of ozone etc *Jr Am Chem Soc 56* 1934 and subsequent papers in the same journal Vassy and Vassy *Jr Chem Phy 16* 1163 1948
[5] Ewell. *Jr App Phy 13* 759 1942

NOTES ON *HILSA KANAGURTA* (BLEEKER) AND *HILSA TOLI* (CUV & VAL)*

These two species of *Hilsa* occur in Madras often in association with *Hilsa ilisha* (Ham) *H kanagurta* attains a size of 12 inches and 2 lbs It enters Lake Pulicat and estuaries and salt water lakes like the Collair Lake and the Muthuppet Swamp It also ascends rivers like the Godavari the Krishna, the Vellar and the Coleroon in small numbers beyond the tidal limit during the flood season It however breeds only within the tidal zone from August to November *H toli* on the other hand, grows to 24 inches and 8 lbs It is a marine form contributing to a commercial fishery along the coasts of Vizagapatam East Godavari West Godavari South Arcot Tanjore Ramnad and Tirunelveli districts It is found in roe from October to January It is commonly captured in drift and gill nets along with the mackerel *Rastrelliger kanagaurta* (Rupp) It feeds mainly on zooplankton whereas *Hilsa kanagurta* consumes both phyto and zooplankton The following is the food composition in percentage of volume of the 260 specimens of the two species obtained mainly from the Godavari delta and coast

	H kanagurta	*H toli*
Number of guts examined	150	110
Gut contents		
Diatomaceae	30 %	5 %
Paralia	x	—
Coscinodiscus	x	
Planktionella	x	—
Detonula	x	
Rhizosolenia	x	x
Chaetoceras	x	x
Biddulphia	x	x
Hemidiscus	x	
Fragilaria	x	
Thalassiothrix	x	
Asterionella	x	
Pleurosigma	x	x
Bacillaria	x	
Nitzschia	x	x
Myxophyceae	18 %	
Aphanocapsa	x	
Spirulina	x	
Oscillatoria	x	—
Chlorophyceae	7 %	
Enteromorpha	x	—
Cladophora	x	
Protozoa	3 %	2%
Prorocentrum		x
Peridinium x	x	
Ceratium	x	x
Crustacea	42 %	90%
Evadne		x
Paracalanus	x	x
Pseudodiaptomus	x	x
Acrocalanus		x
Centropages		x
Acartia	x	x
Oithona		x
Corycaeus		x
Harpacticus	x	x
Euterpina		x
Caridina	x	x
Leucifer	—	x
Acetes		x
Leander		x
Crab Zoea	x	x
Megalopa larvae	x	x
Stomatopod larvae		x
Mollusca.		3%
Cresis	—	x
Spiratella		x

(NOTE x indicates presence of the organism in the gut)

Both the species prefer to feed during the early hours of the day but the guts of several spawners of *Hilsa kanagurta* have been found empty The latter perhaps abstains from feeding during the breeding period The male of this species is smaller than the female and maturity is attained when 5 and 6 inches respectively by the two sexes Its young ones have been observed to mingle and shoal about with *Anodontostoma chacunda* (Hamilton) in the estuaries of the Godavari and Krishna rivers There is no difference between the sexes in the case of *Hilsa toli* in which maturity is attained when 12 inches in length

P I CHACKO
B KRISHNAMURTHI

Freshwater Biological Station
Kilpauk Madras 6 6 1949

*Read before the Zoology section of the 36th Indian Science Congress 1949 and communicated with the kind permission of the Director of Industries and Commerce Madras.

ON THE LATITUDINAL OSCILLATION OF A QUASI STATIONARY BAROMETRIC TROUGH AND THE ASSOCIATED WEATHER

In the pre monsoon months of April and May in India a quasi stationary trough of low pressure oriented more or less in a West East direction exists over Bengal The trough is part of the low pressure centred over north and central India which later becomes the seasonal low of the SW monsoon The trough line is normally quasi stationary and has a mean position along Lat 23½°N over Bengal in April which gradually shifts northward with the advance of the summer During the summer of 1946 a kind of regularity was suspected in the movement of the trough line and its association with the weather of Bengal It was also noted that the type of weather that occurred in association with the trough line seemed to be frontal in character A detailed investigation was, therefore undertaken to study the frontal characteristics of the W E trough line and its movement over Bengal An airmass analysis based on the available upper air data over Calcutta and Lalmonirhat and the air flow over Bengal appeared to bring out clearly that the E ly air that normally flows north of the W E trough line is cooler and drier than the S ly Tropical maritime air south of the trough line This difference in the airmass characteristics seemed to establish the suspected frontal character of the trough line and the special orientation and slope of the frontal surface could also be inferred from the analysis The position of the trough line on the surface was obtained from the surface synoptic chart aided by the upper wind charts plotted for height up to 3000ft a s l The procedure adopted to trace the movement of the trough was to select a suitable system of co ordinates made by a latitude and a longitude and note the position of the trough on the chosen longitude at fixed intervals In the present investigation the ordinate chosen was Long 89°E and the base line was Lat 22½°N This reference system was chosen because of the close proximity of the origin of the system to Calcutta The position of the trough line was determined as two hours daily, *viz*, 0230 and 1130 hours G M T and the weather at Calcutta was noted at each of these hours A graphical representation was then obtained of the latitudinal position of the trough line on successive days by plotting the position against the days of the month The weather at Calcutta was marked in symbols on the base line on the appropriate dates In all, eight graphs were plotted for the four years investigated Those for the months of April and May, 1946, are presented in Fig 1, as typical examples of the movement of the trough line A close study of the curves obtained seems to point to the following interesting conclusions (1) the latitudinal movement of the trough line is oscillatory in character, (2) there appears to be a definite period in the oscillation of the order of about 8 days in April and probably slightly longer in May, (3) the maximum amplitude of the oscillation is about 4 degrees of latitude, (4) the axis of oscillation appears to shift northward with the advance of the premonsoon season, (5) the trough line lying far north of Calcutta, the weather is generally fine over the city except for the occasional visitation of the Nor'westers and Western disturbances But whenever the trough line lies on or in the vicinity of the city, the weather is disturbed, and (6) the correlation of the disturbed weather at Calcutta and the passage or close proximity of the W-E trough line appears to be high

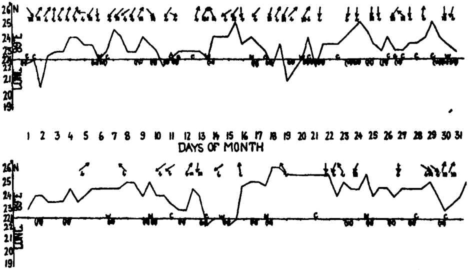


Fig 1 Curves illustrating the latitudinal oscillation of the W E trough line

Upper-Curve—April, 1946, Lower-Curve—May, 1946 The arrows show the available isallobaric winds, direction on 360 points of compass and speed as light, moderate or strong (l, m or s) Weather at Calcutta is shown on the time base in symbols, C—cloudy, N—norwester, W—rain or thunder-storms other than Norwester ( ) denotes past weather

Roy[1] in a paper on the forecasting of rain over south Bengal during the Norwester season, mid March to mid-May, correlated a very high frequency of rainy days over south Bengal with the simultaneous existence of higher barometric pressures at Barisal and Berhampore than at Calcutta and concluded that the favourable condition of a higher pessure at Berhampore than at Calcutta indicated the probable presence of dry and perhaps somewhat cooler land air to the north of deltaic Bengal at some upper level, if not actually on the ground, and perhaps its movement towards deltaic Bengal The present investigation seems to bring forward some evidence in favour of this conclusion in as much as a simultaneous existence of a higher barometric pressure at Berhampore and Barisal is only possible when the W-E trough line lies over south Bengal *i e*, south of Berhampore The movement suspected by Roy also appears to be confirmed But the results of the present investigation are more general and far reaching They should enable the rainfall over the whole of Bengal to be forecast with accuracy if the movement of the trough line could be forecast successfully In the course of the present investigation, it was found that the trough line moves in the direction of the isallobaric gradient and the speed of the movement is proportional to the magnitude of the gradient Isallobaric wind analysis for short periods of time, say, 3 or 6 hours, should, therefore, enable the movement of the trough line to be forecast and followed closely for forecasting the associated weather

The effect of the diurnal oscillation connected with the land and the sea breeze on the movement of the trough line has not been taken into consideration in the present investigation

The details of the paper are being published elsewhere

K R SAHA*

E F T S, R I A F
Jodhpur, 23-6-1949

---

[1] Roy, A K India Meteorological Department, Scientific Note No 83, 1938.

*The writer is indebted to the Air Headquarters, India, for permission to publish this note

THE ANDROECIUM IN CUCURBITACEAE

The morphology of the androecium in Cucurbitaceæ are so peculiar that they have no parallel in the whole plant kingdom As a family Cucurbitaceæ offers us the best material (amongst the phanerogams) for the study of the evolution of reproductive organs particularly the androecium Some members have five stamens each with a two chambered loculus while others show a reduction of the number of stamens to three, two, or even one The partition wall between the pollen chambers breaks down with the maturity of the stamen, resulting in a one chambered pollen sac

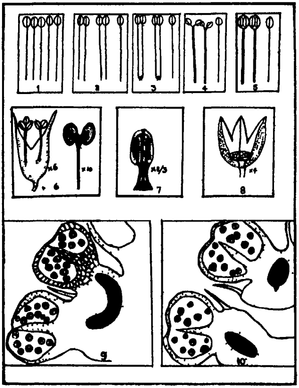
In such genera as *Fevillea*, *Actinostemma*, *Anisosperma*, *Alsomitra*, *Hemsleya*, *Zanonia*, *Gomphogyne* in the tribe *Fevilleæ* there are five stamens all free and alternating with the petals (fig 1) In *Indofevillea* and *Thladiantha* of the five free stamens four have closed up as if to form two pairs, the fifth one standing apart (fig 2) *Neoluffa* an eastern Himalayan genus (recently discovered by the author) shows an advance from *Indofevillea* and *Thladiantha* in that the filaments of the grouped stamens arise from a common place of attachment (fig 3) In *Sicydium*, a South American genus, the filaments of the pair are united below (fig 4) and ultimately in *Trichosanthes Gymnopetalum Benincasa*, *Momordica*, *Cucumis Citrullus*, *Coccinia Bryonopsis Bryonia* and others the androecium is reduced to three stamens (fig 5) Here the filaments as well as the connectives of anthers are united and fused in pairs along the whole length in the paired stamens the odd one however has undergone no change at all

The two loculi in the anther of a paired stamen never fuse but lie side by side over the broad connective In *Luffa tuberosa* Roxb [*Momordica tuberosa* (Roxb) Cogn] a further reduction of the stamens from three to two is marked (fig 6) In this species the staminal number varies from three to two When as usual there are two stamens, one stamen is bipartite and the other tripartite but when the stamens are three one is free and two bipartite each segment of the bipartite stamens however carries only one loculus

In *Curcurbita* the stamens are syngenesious (fig 7) the connective being fused into a central column In *Sechium*, *Sicyos Schizopepon* (certain species) the stamens are monadelphous In *Cyclanthera* the extreme modification of the stamens resulting in the complete fusion of the anthers into a single annular ring with two pollen chambers one above the other is striking (fig 8)

In *Luffa acutangula* (L) Roem the number of stamens fluctuates between five and three, each anther being unilocular when the stamens are five, and one unilocular and two bilocular when the stamens are three

The terminology applied to stamens is confusing According to one school a stamen consists of two fundamental parts (i) the filament and (ii) the anther The other school differentiates a stamen into three distinct parts (i) the filament, (ii) the connective and (iii) the anther Both the schools however agree that in the evolution of the stamens from a foliar origin the filament represents the stalk, the connective represents the midrib and the anther the lamina The more reasonable view will be to differentiate only two parts of a stamen the filament and the anther If the anther represents the lamina and the connective respresents the midrib then we cannot conceive at least in dicotyledons, of a lamina without a midrib Hence the anther must include the connective (the tissue connecting the pollen chambers), the whole being conceived as formed by the inrolling of the margins of the lamina towards the midrib



Stamens in Cucurbitaceae figs 1 5 stages in reductional evolution (diagrammatic) for explanation see text fig 6—*Luffa tuberosa* Roxb fig 7—*Cucurbita pepo* Linn fig 8—*Cyclanthera pedata* Schrad figs 9 and 10 *Cucumis melo* Linn var *superlative* (Sutton) showing the dissolution of partition wall between the pollen chambers ×83

Now in most of the families of the flowering plants the anther is bilobed and each lobe is two chambered (sacs) Hence in an anther there are four pollen chambers Cogniaux[1] described each chamber as a loculus In the Cucurbitaceæ however the anther is two chambered or in other words we may suppose that of the two lobes or thecæ of a normal anther one has been suppressed This type of anther has been described as monothecal by Warming[2] In the Cucurbitaceæ the stamens may therefore be considered as half stamens or more logically half anthered stamens Clarke[3] Roxburgh[4] Prain[5], Hutchinson[6] and almost all taxonomists have described species with three stamens as stamens 3 anthers one 1 celled, two 2 celled which Cogniaux expressed as "*stamina* 3, *antheræ una unilocularis* *ceteræ biloculares* " The loculus of Cogniaux is therefore equivalent to the "cell" of Clarke and others Rendle[7] however described each anther loculus as having two cells, and species with three stamens (two being always compound) he described as 'two with 4 cells and one with 2 cells'

In my opinion loculus is a better expression than cell for anther lobe The term cell should preferably be applied to an internal structural unit Each anther loculus (lobe) of the Cucurbitaceæ is definitely two-chambered (pollen chambers) in the primary stage but the partition wall produced from the back of the loculus to the ventral suture breaks down at maturity* (fig 10), the anther becoming one chambered The partition wall is very thick and several-layered at the base but gradually becomes narrower towards the sutural margin of the loculus (fig 9)

Though the observation of Müller and Pax[8] and Rendle[7] of the two celled structure (2 chambered) of the anther loculus is significant, yet it cannot justly be applied to the mature anther loculus which is one chambered (celled) at maturity, since the anther loculi of the morphologically compound stamens never fuse but lie side by side over the broad connective, though the filaments and the connectives completely fuse The description of Rendle as 'stamens 3, two 4 celled and one 2 celled' is not therefore correct for mature stamens The correct description should be "stamens 3, with two separate anther loculi in 2 stamens (on broad connective) and one anther loculus (on narrower connective) in 1 stamen , anther loculi each 2 chambered before maturity and 1 chambered at maturity " This may be mathematically expressed as (i) $X\ (2+2)+Y\ (2+2)+Z(2)$ in the beginning and (ii) $X\ (1+1)+y\ (1+1)+Z(1)$ at maturity where X and Y represents a paired or compound stamen with 2 anther loculi and Z represents the odd or simple stamen with 1 anther loculus—(i) before maturity and (ii) after maturity

H L CHAKRAVARTY

Royal Botanic Garden,
Edinburgh, 10 3 1949

---

[1] Cogniaux A In De Candolle's Monographia, Phanerogamarum *3*, 325 951 Paris, 1881
—— —In Engler s Das Pflanzenreich, IV *275*, I, 1 267, V, *275*, 2 1 233, Leipzig, 1916, 1924

[2] Warming E Handbook of Systematic Botany (transl by M C Potter) ed II, 478 81 London, 1904

[3] Clarke C B In Hooker s f Flora of British India, II, 604 635 London, 1879

[4] Roxburgh, W Flora Indica, III, 701 728 Serampore, 1832

[5] Prain D Bengal Plants, I, 5 14 53 Calcutta, 1903

[6] Hutchinson J The Families of Flowering Plants, I, 168 London, 1926

[7] Rendle, A B The Classification of Flowering Plants, II, 221, Cambridge, 1938

[8] Muller, E G O and Pax, F In Engler and Prantl's Die Naturlichen Pflanzenfamilien, IV 5, 1 39, Leipzig, 1894

*Observations were made on series of microtome sections (12 15 μ thickness) of the stamens of *Cucumis melo* Linn var *superlative* (Sutton s), *C, sativus* Linn , *Lagenaria vulgaris* Ser , *Luffa acutangula* Roxb *Momordica charantia* Linn , and *Trichosanthes anguina* Linn , Materials were fixed in Medium Chromo Acetic solution or Flemming's fluid, embedded in paraffin and prepared in the usual way Safranin dissolved in 50% alcohol and light green dissolved in clove oil were used as stains

BOOK REVIEWS

Paramagnetic Relaxation—By C J Gorter, Ph D , Elsevier Publishing Co Inc , New York, Amsterdam, London, Brussels, British Distributors Cleaver Hume Press Ltd , 42A South Audley Street, London W 1 Cloth, $5\frac{11}{16}'' \times 7\frac{7}{8}''$ pp vii+127 1947 Price 12s

This specialised monograph by a professor of experimental physics in the University of Leyden, Netherlands, admirably surveys the experimental and theoretical work on paramagnetic relaxation, a subject which has an intimate connection with adiabatic demagnetization, nuclear magnetic relaxation, and theories of the crystalline state As most of the original work on the physics of magnetism carried out in the Netherlands has been published in Dutch, the appearance of this monograph in English, by an outstanding authority and pioneer in the field is very welcome

The introductory chapter deals with normal paramagnetism, crystalline fields and interaction between magnetic ions, and paramagnetic dispersion, including a brief historical sketch In dealing with experimental methods in the next chapter, detailed accounts are given of the heterodyne beat—the calorimetric—and the bridge methods The results of dispersion measurements by these methods are analysed in the next chapter, while the last two sections outline the theory of lattice and spin relaxation, the process of magnetisation, the results obtained so far and the problems awaiting solution

The greater part of this work was written in the grim 1944 45, ' starvation winter ' of Holland when the country was under German occupation and as such the author had no access to the latest Russian and American work on the subject by Zavoisky, Frenkel, Cummerow and Halliday In spite of these great hardships and difficulties, this work, despite a few misspellings and slips in English and the absence of an index surveys in a compact and authoritative manner the highly specialised field of paramagnetic relaxation, offering an erudite physicist specialising in magnetism, a singularly intellectual relaxation

S K G.

Man in the Modern World—By Julian Huxley M A , D Sc , F R S A Meutor Book, published by the New American Library of World Literature, Inc , New York, 1948 Pp 191

This small volume contains thirteen essays which are a selection from his book Man Stands Alone and On Living in a Revolution These range from purely descriptive and popular scientific articles like the Courtship of Animals and the Intelligence of Birds to reflective and philosophical pieces like Religion as an Objective Problem and Philosophy in a World at War Huxley's fame as a powerful and lucid writer who has popularized scientific knowledge for the laymen has been world wide likewise his achievements as a biologist and teacher His greatest contribution lies, to quote his own words in furthering the cause of scientific humanism The essays collected in this book are more or less representative of his wide range of thought and are sure to enrich and refresh the mind of all classes of readers interested in scientific and philosophical ideas The publishers have done a great service to the reading public by making these selected pieces of his writing easily available to all

P R

General and Inorganic Chemistry—By J R Partington, M B E , D Sc , Published by Macmillan &Co , Ltd , London, 1946 Pp 196

The present volume is in many respects an improvement upon the long known *Text Book of Inorganic Chemistry for University Students* by the same author Being of somewhat more advanced character it is intended mainly for the use of Honours students in Chemistry though the junior and Degree students in universities will find it equally useful with the exception of some advanced sections

The book is divided into two parts I and II Part I deals with General and Physical Chemistry while Inorganic Chemistry forms the subject of treatment in Part II The treatment in Part I in many sections is rather more or less condensed and hence might not be easily intelligible to those who have not already acquired a previous knowledge of the subject This is particularly applicable to Chapters IX and X on the Solid State and the Quantum Theory of the Atom respectively

In Part II, devoted to Inorganic Chemistry, the elements are dealt with in the order of their Periodic Groups This part includes more or less all the salient facts of Inorganic Chemistry which a Honours student is expected to know

A happy feature of the book consists in many references to original papers and literature on the subject, which will help the students to acquire a fuller and detailed knowledge

The book can whole heartedly be recommended for use by the university students for whom it has been intended

P. R.

A Text Book of Electricity—By H G Mitchell, M A , B Sc , Published by Methuen & Co, Ltd , 36, Essex Street, London, W C 2 Fifth Edition, Revised Pp 546, 368 Diagrams

This book is intended to provide a complete course in Electricity for Intermediate Science and University Scholarship Candidates The first chapter begins with the elementary definition of Electricity and the treatment of the subjects dealing with Electrostatics, Magnetism, and Current Electricity is thoroughly modern In the chapter on Electromagnetism, a special treatment of the magnetic effects of electric currents has been included This effect has been explained first by magnetic potential methods and then by current element methods The latter chapters provide a detailed account of the practical applications of electricity, alternating currents, electromagnetic waves and electrical conduction Elementary ideas of Electronics and Atomic Physics have been included in a nutshell The book will no doubt be helpful to B Sc pass course students of Indian Universities

B M

Modern Text Book of Intermediate Physics, —By A N Banerjee Published by Das Gupta & Co Ltd , Calcutta 1949 Pp xiv + 555 Price Rs 6/

This is a new text book on General physics Sound and Heat and is meant for the Intermediate course of any of the Indian Universities There are of course, a few such text books published by different authors already available in the market but this particular new text book, inspite of some minor defects, seems to possess some special features First attempt has been made to discuss every topic in detail as should be done in every good text book, and secondly, fundamental topics have been explained clearly in most cases with the help of illustrations These two features have made the book extremely helpful to students of average merit Diagrams have also been drawn neatly to bring out important features effectively Some topics, *e g* , determination of pressure co-efficient of gases, effect of atmospheric pressure on human body, etc included in this book, are not found in some of the other similar text books Finally, the type used in printing is much larger than that used in other text books, which is a great advantage to the beginners

There is, however, much room for improvement which may be effected in the second edition The page-numbering should be continuous throughout the whole volume, more numerical examples and a summary should be included at the end of each chapter and printing mistakes should be avoided more carefully Considering the get up and quality of the paper used, the price of the book appears to be quite moderate

S. C S.

Dictionary of Genetics—By R L Knight, D Sc, Ph D, A I C I A, Published by the Chronica Botanica Co, Waltham, Mass, U S A, Macmillan and Co, Ltd, Calcutta, 1948 Pp ix + 183 Price $ 4 50

This book is the second volume in the serial 'Lotsya—A Biological Miscellany' and is a welcome addition to the long list of very useful publications made by the Chronica Botanica Organization through the able editorship of Dr Frans Verdoorn The author, Senior Economic Geneticist, Empire Cotton Growing Corporation and the Sudan Government, has compiled terms, used both in Genetics as well as in Cytology, Animal breeding and Evolution The science of Genetics which is comparatively young, nevertheless is fast growing, its frontiers extending more and more to other branches of sciences such as Biochemistry, Medical Science, Taxonomy, Ecology etc Consequently interests in the subject is being shown more and more by a wider circle of people Discovery of a new phenomenon or a new interpretation of an established phenomenon is a common feature of the growing literature on this subject with the result that new terms are being coined every now and then Different authors have also, not infrequently, used different terms for explaining the same phenomenon The American and European Schools use two different terms, 'Allele' and 'Factor' respectively for the same purpose The distinction between the terms '*Allele*' '*Factor*' and '*Gene*' is not clear in this book We do not ascribe material entity to 'Factors' or Alleles' as we do to 'Genes' The author has similarly pointed out the difficulty with regard to the use of such terms, '*Centromere*' '*Kinetochore*, *Spindle attachment region*', '*Primary constriction*' etc, all meaning the same thing While by '*Accessory Chromosomes* the author has meant sex chromosomes, Hakansson and others have used it to mean a special type of 'Fragment Chromosome' which has no relation in the differentiation of sex One often has to hunt up books and literature to find out the exact meaning of genetical terms and all concerned will receive with great relief the timely appearance of this book

In a book of this kind it is obvious that many terms would require some explanation and in this respect it is not well balanced Certain terms, we find, are well explained whereas others like '*Incompatibility*,' '*Endosperm* and '*Nucleolus*' remain somewhat obscure The term '*Incompatibility*' has been used in a rather narrow sense It may be noted that there are various degrees of incompatibility even in flowering plants The term '*Nucleolus*' has been merely stated to be a darkly staining body within the nuclei of most cells Surely, this explanation is inadequate for the term We would have welcomed the treatment of terms like '*Spireme*' and '*Telosynapsid*' in some detail, these terms have some historical significance Regarding the term *Nucleoprotein* it would have been better to explain its chemistry and its distribution within the cell There are also certain terms which by their present explanation are not clear or are liable to be misunderstood Under '*Apogamy*' for instance it has been mentioned that the typical embryo is developed by the fusion of two "embryosac cells"! Under '*Embryosac Mother Cell*' it has been said that one of the four cells after tetrad division develops into the embryosac This is only partially true, because all the four cells may take part in the development of the Octo nucleate embryosac '*Fixation*' has been described to be a "process of killing and coagulating *a cell* by means of some physical and chemical agency This meaning is not at all accurate with reference to a plant cell with a cellulose wall "*Genome*', is not merely a chromosome complement of a gamete as stated, as this would not hold good in case of polyploid plants This term has been always used with reference to the basic set and hence require further explanation

The meaning is not clear under '*Haldane's Law*' There appears to be a mistake in the definition of the term '*Matrix*' It is certainly not the peripheral and more stainable portion of a chromosome as is stated

There are altogether eight appendices containing useful formulae and tables for statistical analysis of genetical data The last two contain 'International Rules for Symbolizing Genes and Chromosome Abberations' and 'Distances Recommended to avoid Seed Contamination' respectively

It is hoped that some of the mistakes and obscure explantions referred to above would be attended to in the next edition of this book It is not surprising for a work of this nature to contain such mistakes in its first edition The author himself has expected a few (*vide* his note in the preface) Inspite of these limitations I have no hesitation in recommending the book to all who are interested in biological science

P B.

SCIENCE AND CULTURE

A Monthly Journal of Natural and Cultural Sciences

Vol. 15 OCTOBER 1949 No. 4

IMPASSE IN INDIAN AGRICULTURAL RESEARCH

ATTENTION of the policy makers in our Government, agricultural scientists in the country and of the thoughtful section of the public is invited to an article published elsewhere in this issue, on the organization and operation of agricultural research under the auspices of the Government of the United States of America Research expansion of scientific knowledge is the basis of progress in increased output of agricultural commodities and industrial produce The increased production of agricultural commodities issues from the application of new knowledge gained in the laboratory and the experimental farms by groups of devoted scientific workers The set up that the U S Government maintains for the purpose of solving many problems currently facing agriculture of that country and for discovering new knowledge to advance agricultural prosperity, is sure to prove an interesting study, which will provide many ideas as to how we in India can remedy many defects in our existing agricultural research structure in order to revitalize the country's agriculture and to help solve the many pressing problems that face it The security and the prosperity of our Indian Union and our survival as a nation will depend upon the extent and the speed with which we can discover new knowledge and harness the same to produce two blades of grasses where one grew before, and to conserve whatever we produce

How much application of modern scientific and technical knowledge can revolutionize the agriculture of a country can be judged from the following lines quoted from the 'Report of the Secretary of Agriculture, 1947' of U S A

> "Survey of American Agriculture emphasizes recent improvements which amount practically to a *Technical Revolution* In 1946 the production was 33 per cent greater than the average for the years 1935 1939 About three-quarter of the increase resulted from technological developments, only one-fourth may be attributed to the exceptionally favourable weather of the wartime and early post-war years."

'Calculated in money values, three fourth of this 33 per cent increase in agricultural production amounted to 7 billion dollars (or over 3300 crores of devalued Indian rupees, within the period specified) increase in the national (agricultural) income of the United States, just within a span of a decade This surely represents a big dividend on the 31 million dollars that United States is expending annually on research activities

One of the salient features in the agriculture research set up of U S A is what is known as the Research Bureau each Research Bureau is concerned with a particular branch of agricultural science The naming of the Bureaux indicates the field of their research activities Under the U S Department of Agriculture—there are 6 big Bureaux, *viz*, Bureau of Agricultural and Industrial Chemistry, Bureau of Animal Industry, Bureau of Dairy Industry, Bureau of Entomology and Plant Quarantine, Bureau of Human Nutrition and Home Economics, Bureau of Plant Industry, Soils and Agricultural Engineering and the office of Experiment Stations Besides the above, smaller research units are located in other services, notably the Research Division of the Soil Conservation Service and the Forest and Range Research Branch of the Forest Service

The work of a Bureau is next divided into a number of 'Divisions' on commodity basis, there being separate Research Divisions concerned with cereals, forest crops, fruits, vegetables, etc Besides these, there are a limited number of Divisions under each Bureau mainly performing routine and procedural functions, such as information and publicity, library, financial matters, etc This relieves the Research Divisions from being preoccupied with routine administration and procedural matters

In the present agricultural set-up in India, the higher posts are saddled with a lot of administrative and other routine and procedural matters, too much of their own time as well as those below them are spent on preparing reports and the functioning of the bureaucratic machine They cannot find time for research In course of time they lose by and by all earlier zeal for original investigations, independent thinking and initiative and ultimately add themselves to be a few more spokes in the wheel of the bureaucratic machinery

This situation calls for urgent remedy if any productive and fruitful research is the aim of our agricultural departments, both Central and Provincial Scientific positions should be relieved as far as practicable of routine administrative duties, and it should be the policy of the Government to encourage a man s scientific productiveness rather than his ability to get along with his superiors and his capacity to fit comfortably into a set pattern If a man fits it—well and good, and nobody will ever worry about the fact that he likely is not the most brilliant man in his field

Another situation very much noticeable in our agricultural research structure as in several other fields of our national life, is the lack of co operation between the different research units Co operation in spirit and co ordination of research activities should be actively encouraged by all possible means It has long been recognized that advancement of practical agriculture needs simultaneous attack from several angles, this, therefore, presupposes the active co-operation of all the units The Agricultural Research Administration was therefore, created in 1942 as an agency under the U S Department of Agriculture in order to assist in the over all planning and co ordination of all research carried on by the several independent Research Bureaux, in order to make the most effective and economical use of research facilities, funds, and available technical personnel Now all Research Bureaux doing biological, chemical, physical and agricultural engineering research are placed under the charge of this unified Administration Those who are in touch with the progress of agricultural research activities in the United States know how considerably this Research Administration has been able to bring about effective co ordination in research activities among the different Research Bureaus So much has been its success that the U S President's Scientific Research Board in its ' Report to the President" (1947) paid considerable attention to finding means of bringing about such effective co-ordination, and avoidance of unnecessary duplication in the research programme under the several departments of the U S Government

In the circumstance of our chronic shortage of, research appropriations, of research equipments and related facilities, and of available technical personnel of high ranking capacities, India s need for the creation of such a unit as the Agricultural Research Administration for bringing about much needed effective co ordination of the various phases of agricultural activities in the country is very imperative, if we are to ensure that every pie of the poor-man's tax is to be utilized in the most fruitful and productive manner A simple illustration will bring out the situation clearly to improve the milk supply in the country better herds of cow need be raised through breeding with high quality stocks The new breed of cows raised should next be ensured of proper type, quality and adequate supply of feed These need simultaneous investigations by plant scientists to help availability of proper type of feed or to hybridize new varieties of forage crops preferred by the new breed of the herd To determine the effect of different type of feed on the yield, quality and fat content of milk, the co operation of the nutrition chemists is called for Industrial chemist comes to play his part if we are to assure that milk products, such as butter, etc are prepared and preserved in the best manner Veterinary personnel cannot be left out of the picture as the improved breed of cattle will need constant attention to save them against numerous diseases and infestation by many insects To study the habits and biology of insects infesting the cow, services of entomologist becomes essential, and so on

So when a new project of work is undertaken there should be means to set in motion investigations on the related phases of the central problem, because solution of one phase of the work without solving the other phases, though minor, will not be productive in the long run Such simultaneous attack on a pressing problem can only be effected if there be created an organization with powers to co ordinate work in the laboratories, say, of the animal husbandry, veterinary, entomology agronomy, and agricultural chemistry branches of the Central Ministry of Agriculture

Organization of agricultural research in India is, of course, recent in origin but the disquieting factor is that it is not showing signs of a promising and useful career In 1903 a Central Agricultural Institute was established at Pusa, Bihar The present Indian Agricultural Research Institute at New Delhi is its successor This institute has once done very important work in the field of entomology plant diseases, etc , but with a few exceptions, we do not find now that brilliant galaxy of workers that once adorned its desks After the Bihar Earthquake of 1934, when the buildings of the Pusa Institute were severely damaged, the Institute was removed to Delhi through the zid of the late Sir Fazli Hussain Member, Education, Health and Lands, Government of India and a few over zealous bureaucrats, against the almost unanimous opposition of all groups of Indian scientists After that, like all scientific research institutes of Government at Delhi, this has remained an anaemic plant for a long time It is a happy sign to note that within the past few years a promising group of workers, who have established their reputation as first rate investigators under university atmosphere, have been recruited for the Institute It is hoped that they will be able to break the impasse and help to create an atmosphere so essential for productive and fundamental research, which is the object of the Indian Agricultural Institute Three other noteworthy institutions of the above type are the Indian Veterinary Research Institute at Izatnagar and Mukteswar, Indian Dairy Research Institute at Bangalore, and the Forest Research Institute at Dehra Dun

The Indian Council of Agricultural Research established in 1929 is another very important organization in the agricultural research structure of the country Its object is to initiate, organize and finance research Twenty years have since elapsed, but we do not find much productive or fundamental research to its credit except the establishment of a few commodity stations under its auspices Some of the commodity stations are doing very useful work, while a few still exist in the confines of the secretariat buildings with no laboratory of their own There is a lack of co-ordination of work of the different commodity stations Another line of its activity is the financing of research schemes in the Universities, privately endowed laboratories or under the provincial agricultural departments Most of these schemes are on a basis of 2 to 3 years duration and there is indication that grant of such finance is bestowed not always on the intrinsic capacity of the man to be in charge of its guidance but on the position he happens to occupy or on the political hold he has had, or even by way of patronizing This situation calls for urgent remedy Instead of initiating research scheme of 2 to 3 years duration it would be a better policy to finance investigations in the University or elsewhere which have already produced convincing results and is pregnant with further possibilities but is hampered by want of funds

Quality of scientific research in the country has evoked criticism from many responsible quarters Even our Prime Minister dwelt on this subject in his speech at the Indian Institute of Science, Bangalore, several months ago What has been said of other sciences is applicable to even a greater extent on the quality of agricultural research in the country Those who enter into Government Research Institute after having experience of work in University Laboratories badly feel the absence of "research climate', evaluation of a worker in a Government department is made not on the basis of his independent thinking and his talent in initiating new ideals, but by his submission to the existing affairs of things Added to such organizational limitation, the young enthusiast finds himself burdened with domestic and social commitments in his limited monthly emoluments The red tape of Government departments with its unending files, allurement of administrative post with greater power and higher emoluments that go with it—all make an alluring "grave" for many of our brilliant young investigators

While every endeavour must be made to remedy the many existing defects some of which have been discussed above, it should be admitted that the present agricultural organization at the Centre or the provinces are too small to adequately handle the many pressing problems that face the country s agriculture Agriculture is much more developed in the United States, the cultivator has much more private resources and has often more educational background to profit by common knowledge, and even then to help him the United States Department of Agriculture maintains an army of over 7500 technical personnel for research alone and currently expends over 31 million dollars a year for research Expenditure by types of research is as follows fundamental research—$ 2 4 million, developmental research—$ 4 4 million, background research—$ 10 7 million, and applied research —$ 13 7 million No comparable figures of technical personnel or of expenditure for research activities or by types of research at the centre (or in the provinces) are available But they must be very small compared with the task that faces the country

Major agricultural advance can accrue only after we have gained much more knowledge concerning, the fundamental biology of our crop plants and farm animals Great advances in field and soil practices, control of pests and plant diseases, mechanization of farming operations, and plant improvement have already been made in many progressive countries There is hardly any doubt that our stability and future well being as a nation will largely depend on our ability to harness such knowledge in improving the agricultural production in the country, where 75 percent of the population is directly dependent on agriculture and where population is increasing so rapidly that without concurrent increase in agricultural production it would mean more impoverishment of the existing very low level of diet, let alone increasing the standard of nutrition and living for the masses

ORGANIZATION AND OPERATION OF AGRICULTURAL RESEARCH IN THE UNITED STATES

J C SAHA

THE key to the prosperity that obtains today in the United States of America is to be found in her reliance on research in physical, biological and technical sciences to achieve new results and to make 'the best still better[1] ' What research has been able to achieve for that country can be gauged from the authoritative statement quoted below

> "The processes and machines we use in our factories the ways in which we raise and preserve our food, all derive from theoretical discoveries in the various sciences. The technology in which we excel and which has transformed us in some 80 years from a backward agricultural nation to a world power rests upon progress in the basic sciences Only through research and more research can we provide the basis for an expanding economy, and continued high levels of employment ' (p 4)[1]

In 1947, 1160 million dollars were expended in the United States on research (excluding atomic energy which spent nearly 700 million dollars) Of these Federal Government expended 625 million dollars, Universities 45 million dollars, industries 450 million dollars, and other 40 million dollars The application of the new knowledge thus gained in the laboratories to the production of new and better types of agricultural and industrial commodities and their effect on the economy of the country is reflected in the ever increasing standard of living of the masses of that country The present article will, however, be limited, understandably, to a brief account of the U S Government

Agricultural Research under U S Government Agricultural research carried under U S Government is under the direct charge of the U S Department of Agriculture In the Act establishing the U S Department of Agriculture in 1862, the U S Congress laid, wisely enough, special emphasis on research and charged that

> "the general designs and duties (of the U.S Department of Agriculture) shall be to acquire and to diffuse among the people of the United States, useful information on subjects connected with agriculture in the most general and comprehensive sense of the word "

As such, it is natural for the Department to lay great emphasis on research, research, therefore, forms a major function and is intimately associated with all other functions and has a direct bearing upon virtually all other activities of the Department

Types of Research Until a decade ago, physical and biological research in the Department has been almost entirely applied and developmental to meet current needs of the farmers and the agriculture-based industries The various research Bureaus of the Department met the normal and anticipated needs in those respects

But special organizations have later been set up exclusively to meet special needs An outstanding example is the establishment in 1938 of 4 Regional Research Laboratories dedicated to the discovery of new industrial uses for surplus farm commodities which were crushing the farmers and plaguing the U S national economy in mid 1930's Five million dollars are currently expended on research on such phases of work in the Regional Research Laboratories under the supervision of the Bureau of Industrial and Agricultural Chemistry

During recent years nearly equal emphasis is being placed in the United States on basic and fundamental research The Bankhead Jones Act of 1935 specially provided for the establishment of field laboratories for long range basic or background research Nine laboratories were soon established 3 of these laboratories are devoted to special crop problems, 2 on special soil problems, and 4 on special livestock problems The Regional Research Laboratories and the Bankhead Jones Laboratories are under the general management of the appropriate research bureaus

Research Agencies under the Department Nearly all research activities of the Department is performed by the research bureaus of the Agricultural Research Administration The naming of the bureaus, enumerated below, indicates the principal lines of activities they are directly concerned with, as such no space will be wasted to add additional explanation

(a) *Bureau of Agricultural and Industrial Chemistry*
  1 Northern Regional Research Laboratory at Peoria (Illinois)
  2 Southern Regional Research Laboratory at New Orleans (Louisiana)
  3 Eastern Regional Research Laboratory at Wyndmoor (Pennsylvania)
  4 Western Regional Research Laboratory at Albany (California)

(b) *Bureau of Animal Industry*
  1 U S Regional Swine Breeding Laboratory at Ames (Iowa)
  2 U S Regional Sheep Breeding Laboratory at Dubois (Idaho)
  3 U S Regional Laboratory for Improvement of Vitality of Poultry at East Lansing (Michigan)
  4 U S. Regional Animal Disease Laboratory at Anburn (Alabama)

(c) *Bureau of Dairy Industry*
(d) *Bureau of Entomology and Plant Quarantine*

---

[1] Science and Public Policy, Vol 1 A Program for the Nation. A report to the (U.S) President by John R Steelman, Chairman, The (U S) Presidents Scientific Research Board, 1947.

(e) *Bureau of Human Nutrition and Home Economics*
(f) *Bureau of Plant Industry, Soils, and Agricultural Engineering*
  1 U S Regional Salinity Laboratory at Reverside (California)
  2 U S Regional Plant Soil and Nutrition Laboratory at Ithaca (New York)
  3 U S Regional Pasture Research Laboratory at State College (Pennsylvania)
  4 U S Regional Vegetable Breeding Laboratory at Charleston (South Carolina)
  5 U S Regional Soyabean Laboratory at Urbana (Illinois)
(g) *Office of Experiment Stations*
(h) *Forest Service**
(i) *Soil Conservation Service**
( ) *Production and Marketing Administration**

The work of a Bureau is next divided into a number of Divisions and the divisions into a number of 'Sections' There are 2 kinds of Divisions under each Bureau a limited number of Divisions under a Bureau is mainly concerned with administrative and procedural matters, *viz*, Divisions of Administration and Personnel Management, Division of Finance, Division of Information, Division of Library etc, are known as Service Division the second category is concerned exclusively with research and is known as Subject Matter (or Research) Divisions such as Division of Cereal Crops and Diseases, Division of Mycological Collections and Disease Survey, Division of Farm Power and Machinery, Division of Mechanical Processing of Farm Products, Division of Biologically Active Compounds, Division of Phytochemical Research, etc, etc

Depending on the size of the Bureau there are 2 to 5 Service Divisions and 10 to 20 Subject Matter Divisions under each of the Bureaus

Principal Lines of Research Activities

It is impossible in an article of this nature to give a detailed account even of all the principal items of current research activities of the research agencies under the Department However, an attempt will be made below to mention in broad outlines some of the major and important items of research activities under the respective agencies

Bureau of Agricultural and Industrial Chemistry

It is one of the major research bureaus of the Department Its principal lines of work comprise chemical, physical and engineering research into the properties of farm commodities and to the development of new and wider industrial, food, and feed uses for agricultural commodities

During the World War II, the activities of the Bureau was mainly directed to the utilization of agricultural commodities for the development of critical or strategic materials then in short supply, such as, penicillin, allergenic properties of vaccines, special cellulose pulps for gas mask filters, dehydration of fruits and vegetables for overseas armies, etc

In peace time the Bureau s research is mainly directed to the utilization of impending or currently surplus commodities such as cotton, potatoes, and wheat, and utilization of agricultural residues and wastes such as straw vegetable and fruit cannery wastes, poultry feathers, etc, and also the development of improved equipment and processes for the purpose

The research activities under the Bureau may be classified into major research fields as under

Chemistry About 412 persons half of them professional workers were engaged and over 1 75 million dollars were expended in 1947 on chemical research Some of the major lines of investigations comprise (*i*) chemical finishing of cotton textiles (in pilot plant scales) through impregnation with chemicals to improve texture, quality and durability (*ii*) isolation, identification and evaluations of oils proteins and carbohydrates of peanut, soyabean, casein, milk whey proteins, etc designed to their industrial utilization in the shape of fibres emulsions, gels, and adhesives (*iii*) development of new industrial uses for starch and dextrose obtained from corn wheat and other cereals, (*iv*) research on utilization of carbohydrates as resin coatings, plasticizers and *elastomers* etc, and (*v*) research on plant enzymes in relation to ripening processes for their possible utilization to hasten the ripening of citrus fruits and grains to make the fruits sweeter and the grains to store longer and better and to increase the latter s malt potency

Chemical Technology Research is designed to the development of new processing techniques in order to help retain colour, flavour and nutritive value of processed fruits and vegetables Considerable attention is being given for the past few years on methods of quick freezing of fruits and vegetables which are currently receiving favours with the farmers and the consumers in the United States

Nearly 0 3 million dollars were spent in 1947 on such phases of investigations

Chemical Engineering Most of its activities are designed to developing production methods under pilot plants scheme of promising results obtained in laboratory scale Another line of work is research on the production of synthetic fuels from agricultural and forest commodities (although investigations of synthetic liquid fuels from coal and oil shales are under the Department of Interior)

Investigations are in progress in the Northern Regional Laboratory to develop a process to obtain, fermentable sugars from agricultural wastes for production of liquid fuels. A survey of available agricultural wastes for saccharification shows that there are sufficient corncobs and other crop residues currently available in the United States to feed 15 synthetic fuel plants each using 100 000 to 200 000 tons of agricultural wastes and with a combined production capacity of 170 million gallons of synthetic fuel

---

*These are not primarily research agencies, but carry on a considerable research and investigatory work principally on physical sciences so far as they relate to the efficient discharge of their program of administrative, operating and service duties.

Microbiology The major lines of work under this head is the development of new fermentation processes for the production of industrially important chemicals and the maintenance of a culture collection of micro organisms

Blended Research Nearly 40 per cent of the total budget of the Bureau is spent on research combining the above types in order to advance the utilization farm commodities

Regional Research Laboratories Nearly 90 per cent of the investigations of the Bureau is carried at one or other of the 4 Regional Research Laboratories, the latter are located in the 4 major agricultural regions of U S A and each is primarily concerned with research on the industrial uses of farm produce of the respective agricultural region of the United States

Northern Regional Research Laboratory, located at Peoria (Illinois), is engaged to finding new industrial uses of corn, wheat, other cereals, soyabeans and other oil seed crops, agricultural residues such as straw and stalk

Southern Regional Research Laboratory located at New Orleans (Louisiana) concerns itself on similar studies relative to cotton, sweet potatoes, ground nut and other oil seed crops mainly grown in that region

Eastern Regional Research Laboratory located at Wyndmoor (Pennsylvania), is engaged on investigations on such crops as tobacco, potatoes, apples and other fruits and vegetables, tanning materials, hides and skin, milk products, and animal fats and oils

Western Regional Research Laboratory, located at Albany (California), is devoted to research in respect, principally to fruits, vegetables, alfalfa, poultry and by products

Besides applied research on the above principal commodities, important basic research is being carried on antibiotics In fact Northern Regional Research Laboratory is one of the independent discoverers of polymyxing which has been found to be highly effective against plague, typhoid, undulent fever, one type of pneumonia bacteria under experimental conditions

The Western Regional Research Laboratory is now engaged in the production and evaluation of the antibiotic, Subtilin, potentially effective against a bovine mastitis, rickettsial infection, tropical ulcers, etc

Bureau of Animal Industry Research under this Bureau is concerned with animal husbandry and production and protection of farm animals (except dairy cattle) against diseases, and also administration of Federal Meat Act

Animal Husbandry and Production Studies Research in this Bureau relates to breeding, stock improvement, feeding, management of farm animals, fur-bearing animals, poultry and improvement in the technology of animal products

Animal Diseases Studies Many million dollars' worth of potential leather, bacon, steak livers are lost, as in any other country, in the U S A every year A major item of research is directed to the prevention and cure of brucettosis (contagious abortion) among livestock This disease takes a toll of about 50 million dollars' worth of potential livestock every year

Another line of major investigation is concerned with protozoan and helminth parasites of livestock and poultry

Other lines of research are directed to control the bacterial and fungal diseases of livestock and poultry and to developing drugs for treating animals infested with external parasites

Bureau of Dairy Industry The research programme of the Bureau is directed to promoting the growth and increasing the efficiency of the dairy industry in that country The following are the major categories of research

Breeding and Management Studies Improvement in producing ability of Beltsville Holstein herd is being made through the continuous use of production-proved sires

Very encouraging results have been obtained towards development of breed of heat resistant dairy cattle suitable for herding under the climatic conditions of the Southern United States, particularly the extremes of heat and humidity along the Gulf Coast Two bulls and 2 heifers of Red Sindhi (Brahmin cattle) breed were imported into the United States in 1946 and they were crossed with Jersey breed to impart to the Red Sindhi-Jersey calves the resistance to heat, pests and drought of the Indian breed with the dairy qualities of that country's domestic dairy cattle

Mastitis is a very common malady among dairy herd Research directed to the improvement, management methods and application of penicillin have proved effective in controlling mastitis among the experimental herds

Nutrition and Physiological Investigations Most of these studies are directed to discovering the nutritional and physiological factors which control the growth, development and quantity and quality of yield of cows and calves Results of recent investigations in the Bureau have shown that (i) cows produce equally well on less protein diet than ordinarily recommended, (ii) that individual cows differ in their response to thyroprotein feeding, (iii) that dairy heifers could be successfully raised on roughage alone from 10 months of age to calving time, (iv) that corn silage feed as sole roughage is adequate for growth reproduction and production of milk, (v) that alfalfa silage or barn-cured hay gives more milk per acre than field cured hay, and (vi) that 5 year pasture and crop rotation system gives better yields than permanent pasture etc

Milk and Dairy Products Investigations Research under the head is aimed at improving the techniques of manufactures and improving the quality of dairy products and finding industrial uses for dairy by products Recent studies have shown that oxidized flavour of the milk is developed in storage when the milk contains air, the oxygen of the latter reacts with the vitamin C present in fresh milk forming dehydro ascorbic acid, which develops the off flavour Experiments have shown that oxidized flavour can be prevented by adding ascorbic acid or removing the oxygen by spraying the warm milk into a chamber under high vacuum (deaeration), or by doing both

Other major lines of research are those concerned with developing processes for recovering proteins from cheese whey and of making protective coating materials from lactic acid

An efficient method has recently been developed by the Bureau for fermenting lactose (milk sugar) in whey to ethyl alcohol This will help industrial use of huge quantities of whey produced as by product in cheese and casein factories and help solution of enormous quantity of whey wastes

Bureau of Entomology and Plant Quarantine The Bureau carries on investigations on insects, gives advice on how to control or use them, control and prevent the spread of injurious agricultural pests and diseases in co operation with States and local agencies and administers the Federal Plant Quarantine Acts

The main lines of research include, among many others, the following

Insect Investigations These include varied field of studies including the identification, classification life history and habit studies, of injurious agricultural and household insect pests with a view to aid in their effective control

Insecticide Investigations These include the test on laboratory and field scale of known insecticides and the extraction of new and deadlier insecticides from plant sources or synthesis of new ones

One of the most recent achievements by the Bureau scientists (in co operation of the Bureau of Agricultural and Industrial Chemistry) is the chemical synthesis of pyrethrin, the effective factor of the natural pyrethrum extracts

Bee Culture Investigations Research under this head is directed to eliminate or reduce bee diseases —particularly the deadly American foulbrood - for improving apiary management and artificial insemination to develop strains of superior breeds of queens Feeding of sulfathiazole with sugar syrup has proved effective in retarding the germination of American foulbrood spores injested by the bee larvæ until the latter have passed off the susceptible period Artificially inseminated queen bees have shown high resistance to the American foulbrood disease

Bureau of Human Nutrition and Home Economics Two major lines of research under the Bureau comprise investigations on (i) the basic human needs for food, clothing housing, and other goods and services, and (ii) relative utility and economy of available goods to meet basic human needs

The Bureau's research programme include (a) studies on nutritive value of different items of the diet and how people of lower income brackets can have a balanced diet in their current level of income, (b) studies on the comparative utility and cost of fabrics and garments and improvement in the case of fabrics to ensure longer service, (c) studies directed to aiding families of lower income group with selection, care and use of household equipment, (d)studies to determine the better planning and design of cheaper houses, and (e) studies in co operation with manufacturers, to improving performances of common household equipments and home canning gadgets and their care

Bureau of Plant Industry, Soils, and Agricultural Industries This is the largest of all the research bureaus Over 1 800 workers were engaged under its different projects in 1947 with a total appropriation of more than 7 million dollars Of these 5 million dollars were spent on applied and developmental research while the rest 2 millon dollars were spent on background research

The Bureau's research programme falls under the following three major heads (i) improvement in crop production, (ii) classification and improvement of soils, and (iii)engineering problems connected with crop production primary processing and improved design and construction of farm machines and farm buldings Some of the principal lines of research are

New crops Introduction Soybean is one of the introduced crops that in performance and utility has surpassed even the fondest hopes of the early pioneers in plant introduction One of the most versatile products of American agriculture, its uses include products used as livestock feed, human foods, edible and industrial oils, shortening margarine, paints, varnishes, adhesives soaps plastics, vegetable fibre, printing ink, synthetic rubber, etc

In 1946, farm value of the soybean crop was estimated at over 500 million dollars, over 150 mills are currently engaged in processing the soybean for oil meal alone, providing direct employment to many thousand of workers Other notable introductions are alfalfa and tung oil nut trees.

The Bureau spent over 74,000 dollars in 1947 on work related to foreign plant introduction

Production Breeding Disease, and Quality Investigations Research projects are designed to develop varieties of crops and fruits that will escape production hazards, resist diseases and pests better, withstand drought

Handling, Transportation, and Storage of Fruits and Vegetables Investigations One of the major items in the research programme of the Bureau is concerned with the improvement in the methods of harvesting, packing, shipping, storing and refrigeration of fruits, nuts, and vegetables, to maintain maximum quality from time of harvest until they reach the consumer

Over 250,000 dollars were spent in 1947 on such items of research

Plant Diseases Investigations Besides trials of different fungicides to determine the most effective method of plant disease control, the Bureau has recently started a Disease Forecast and Information Service in respect of a few important crops This serves as an warning to farmers through radio, telephonic or press messages of any expected outbreaks of diseases They enable the farmers to keep in readiness to applying the required dusting or spraying of fungicides A large sum is thus saved to the farmers as they can now do away with routine sprayings, which mean only wastage of material and money when no epiphytotics occur

Weed control Investigations Research is directed to testing and evaluating available herbicides in eradicating noxious weeds and the residual effects of such herbicides and flame throwers and other methods of weed control on the soils

Miscellaneous Plant Science Studies Investigations on the nutrition and manner of utilization of fertilizers through the use of isotopes The radioactive phosphate used differs from the ordinary fertilizer phosphate in that it gives off radiation wherever it goes in the soil or throughout the various plant parts In the detector used (Geiger counter) this tracer phosphate, wherever it is, literally rings a bell, indicating its movement and also make it possible to determine where the plant had obtained the phosphate it has used—whether from the store of phosphates already present in the soil or from the doses of "tagged" radio active materials This is opening a vast field of insight into the physiological processes in plants

Office of Experiment Stations The office of Experiment Stations does not carry any research itself nor it has any laboratories under its direct management But it plays a very important part in the research activities of the State Agricultural Experiment Stations Its function is to administer Federal grants for research in agriculture and rural life made available to the Agricultural Experiment Stations of the 48 States and the United States territories of Hawaii, and Puerto Rico through annual congressional appropriations under the provisions of Hatch, Adams and Purnell Acts.

The Agricultural Experiment Stations are located in the States or territories, at least one in each of them and was established as a part of the land grant colleges (usually of an university status, where the leading object is to teach such branches of learning as are related to agricultural and the mechanical arts)

In 1947, over 20 million dollars were expended by these State Agricultural Experiment Stations 13 million dollars were appopriated by the respective States or territories, while the remaining 7 million dollars were met from the Federal Funds under the above Acts

The office of Experiment Stations does not dictate what research projects are to be undertaken at any of the States Agricultural Experiment Stations but merely indicates probable research lines of importance, acts as a clearing house of information and exchange of ideas and especially coordinates the work of the State Agricultural Experiment Stations with the activities of the U S Department of Agriculture

It encourages co operation and suggests co operative research among the State Agricultural Experiment Stations to promote solution of problems that extend outside the borders of any one State and which are beyond the means of any one State to solve all by itself During the review of research projects submitted by the States for formal approval, the Office of Experiment Stations calls attention to pertinent research at other State Agricultural Experiment Stations or in the U S Department of Agriculture itself, suggests the possibilities of exchange of information or arranges to draw formal Memoranda of terms and understanding for co operative research

The development of hybrid corn is one of the best examples of co operative research project between several State Agricultural Experiment Stations and the U S Department of Agriculture The effect of the achievement of this research project on the general economy of the United States can be gauged from the recent testimony of Dr L J Stadler, a United States Department of Agriculture co operator at the University of Missouri, before the Committee on Military Affairs of the U S Senate

> "A conservative estimate of the increase in national corn production during the 4 years, 1942 1945, due to the partial use of hybrid corn, is 1,000,000,000 bushels The money value of this increase on the basis of farm prices per bushel is more than two billion dollars It is, therefore, no exaggeration to say, speaking in terms of the over all national economy, that the dividend on our research investment in hybrid corn during the war years alone, was enough to pay the money cost of the development of the atomic bomb" (p 4)[1]

Forest Service Although mainly a service and administrative agency for protection, improvement and management of 180 million acres of forest and range land (of the U S National Forests), wild lives, and sale of timber, it carries out research on several matters related to the above functions The research under this agency falls under the following categories

---

[1] *USDA*, July 4, 1949 Office of Information, U.S. Department of Agriculture, Washington, D.C.

Research on Utilization of Forest Products Research is conducted for producing better pulp quality and higher yield from native species It relates to developing new methods and improvement of techniques to conditioning and protecting veneers, ply wood, laminated woods, other glued woods, fire, decay, and weathering resistance and also properties investigations and wood products development

Water Resource Research Investigations are designed to finding the influence of natural vegetation cover on water resources, water run off, stream flow, erosion and flood control

Its research programme is designed to assist in the efficient discharge of the above functions assigned to it Its research falls under the following major categories In 1947, it spent nearly 1 5 million dollars on research

Erosion Control Research It is designed to finding the effect of different farm crops on soil erosion and its control, as well as studies on the physical and chemical nature of soil in relation to soil conservation practices

Irrigation, Drainage and Water Conservation Research Studies on these phases are carried in 17 Western States, where water supply is scarce Investigations are designed to finding methods to reduce transmission loss due to seepage in ditches and irrigation canals through growth of aquatic plants, improve methods of irrigation channel layout and construction, etc

U S DEPARTMENT OF AGRICULTURE

PERSONNEL AND EXPENDITURE (IN THOUSANDS OF DOLLARS) FOR RESEARCH FISCAL YEAR 1947[a]

Bureau	Personnel			Expenditure by type of research				
	Total	Professional	Other	Total	Fundamental	Background	Applied	Development
Total	7 577	3 431	4 146	$31 327 7	$ 2 471 1	$ 10 728 2	$13 711 0	$ 4 417 4
Bureau of Agricultural and Industrial Chemistry	976	455	512	4 235 8	528 3	1,471 7	1 272 6	963 2
Bureau of Animal Industry	554	150	404	2 211 3	845 3	423 6	842 9	99 5
Bureau of Dairy Industry	232	64	168	1 022 0		577 0	437 0	8 0
Bureau of Entomology and Plant Quarantine	699	380	319	3 189 2		1,075 6	1,759 9	362 7
Bureau of Human Nutrition and Home Economics	171	100	71	712 7	265 8	36 8		410 1
Bureau of Plant Industry Soils and Agricultural Chemistry	1,820	797	1 023	7 142 4	63 9	1 833 6	3 854 2	1 390 7
Office of Experiment Stations*	1 699	835	864	6 210 5		3,114 1	2,948 7	147 7
Forest Service	950	433	517	4 486 0	689 4	2 127 8	1 314 6	354 2
Soil Conservation Service	327	142	185	1 423 0	78 4	42 7	1 200 7	101 2
Production and Marketing Administration	158	75	83	685 8		25 3	80 4	580 1

[a] Science and Public Policy Vol 11 The Federal Research Program A Report to the (U S) President by John R Steelman, Chairman The (U S) Presidents Scientific Research Board, 1947

†Federal grants to the States for agricultural research at the Agricultural Experiment Stations of the individual States and of U S Territories

Range and Forest Management Research These include studies on the ecology, physiology and genetics of forest trees, natural regeneration, and methods of proper management to ensure sustained high production of forest wealth

Soil Conservation Service This agency is mainly a service agency providing technical assistance to farms in conservation, surveying, planning water conservation practices on individual farms, watersheds, etc , and providing equipment when needed.

Production and Marketing Administration This agency is concerned with administrative and advisory functions connected with production, marketing and consumption of agricultural commodities Incidental to the efficient discharge of the functions, this Administration carries on several physical research In case research on biological aspects of some agricultural commodities are considered necessary, money is placed at the disposal of the appropriate research bureau with proper facilities for undertaking the particular piece of investigation

The physical research operated by this Administration falls under 2 broad types

Marketing Facilities and Practices Investigations are undertaken to study and improve methods of commodity transportation storage, packing handling, etc

Grades and Standards Nearly $ 350,000 are spent annually for investigations concerning improvement in the methods and technique of grading and standardizing fruits, vegetables, poultry tobacco, cotton and cotton seeds, grains, etc

Planning and Co ordination of Research

To assist in the over head planning and co ordination of all research carried on by the 'independent bureaus, and to make the most economic and effective uses of the available research facilities, funds and technical personnel the Agricultural Research Administration was, therefore, created in 1942 All the research bureaus doing biological, physical, chemical, and agricultural engineering research in the Department are under this one over all Administration Administration of the research, including co ordination among different research bureaus, is performed as a service to the research and is not tinted with any dictatorial odour Because of the effective co ordination this Administration was able to bring about in the research programme under the various bureaus within the few years of its establishment The Agricultural Research Administration is now entrusted with the co ordination of almost all research activities under the U S Department of Agriculture

Co operation and co ordination of research programme of the agricultural experiment stations of the 48 States and of the research bureaus and of other agencies having research functions is effected through the intermediate of the Office of Experiment Stations So great is the co operation and co ordination that different facets of a single problem may be supported by both the Federal funds and State grants The same worker may perform both the work of the State Agricultural Experiment Station and that under the Federal grant funds, his salary being book adjusted according to the time he devotes on either of the project The same scientist may supervise men paid by either fund The Office of Exeriment Stations is in intimate touch with the Agricultural Research Administration the head of the Office of Experiment Stations being one of the Assistant Administrators of the Agricultural Research Administration

'Project' System of Research Budgeting and Accounting In order to improve upon budgeting and fiscal accounting of research activities, the Agricultural Research Administration has been using for the past several years what is known as a project system This new system helps find out how much money has been expended on research in respect of a particular crop as well as on a particular line of investigation concerning the same crop, and to help determine what achievement has been obtained in relation to the amount of money already expended

Taking the budget, say, of the Bureau of Plant Industry, Soils, and Agricultural Engineering, as an example, the entire budget of the Bureau is first divided, barring intricacies of supplemental funds, into a number of appropriations,' such as (1) Field Crops Appropriation, (2) Fruits, Vegetables, and Special Crops Appropriation, (3) Forest Diseases Appropriation, (4) National Arboratum Appropriation, (5) Soils, Fertilizers, and Irrigation Appropriation, and (6) Agricultural Engineering Appropriation

Since an 'appropriation' covers a wide range, it is next subdivided into a number of 'financial projects' For example the Field Crops Appropriation is subdivided into the following 'financial projects' (*i*) Cereal Production, Breeding, Disease, and Quality Investigations, (*ii*) Cotton Production, Breeding, Disease, and Quality Investigations, (*iii*) Fiber Plants other than Cotton, (*iv*) Forage Crop Production, Breeding, Disease and Quality Investigations, (*v*) Rubber Production, Breeding and Disease Investigation, (*vi*) Sugar plant Production, Breeding, Disease and Quality Investigations, (*vii*) Tobacco Production Breeding, Disease and Quality Investigations, (*viii*) Food, Feed, and Forage crop Investigations in Alaska, and (*ix*) Repair and Reconstruction of Physical Facilities at Field Stations and Laboratories

A financial project is next divided into a number of 'work projects All works in respect of rice crop comprise one work project, those concerning wheat form another work project, and so on

Each work project is comprised of a number of 'line project A line project represents a rather narrow phase of research Investigations regarding disease control of rice crop comprise one line project, breeding disease resistant rice varieties comprise a second line project, research regarding quality improvement of rice may form a third line project, and so on and so forth, under the main work project concerning the rice crop

The project system of research budgeting and accounting is being extensively used by the (Agricultural Research) Administration in keeping record of all research in progress and for getting team work between the different units of the Administration" (p 6)[4]

---

[4] The Administration of Federal Research A talk by W V Lambert Administrator, Agricultural Research Administration U S Department of Agriculture before the Amer Assoc Adv Sci, Chicago, Ills, December 29, 1947 (mimeographed)

SOCIAL PHYSICS

V K K MENON

MINISTRY OF DEFENCE, NEW DELHI

PROFESSOR John Q Stewart[1] of the Princeton University Observatory writes at the end of his interesting and thought-provoking paper on "Empirical mathematical rules concerning the distribution and equilibrium of population "

"There is no longer excuse for anyone to ignore the fact that human beings, on the average and at least in certain circumstances, obey mathematical rules resembling in a general way some of the primitive 'laws' of physics "Social Physics" lies within the grasp of scholarship that is unprejudiced and truly modern When we have found it, people will wonder at the blind opposition its first proponents encountered "

"Meanwhile, let 'social planners' beware! Water must be pumped to flow uphill, and natural tendencies in human relations cannot be combated and controlled by singing to them The architect must accept and understand the law of gravity and the limitations of materials The city or national planner likewise must adapt his studies to natural principles "

' Social Physics" represents a numerical and quantitative approach in the study of social phenomenon It is not social science as ordinarily understood In fact it aims at introducing into social science the language of size, number and measurement The social activities of men depend on such a variety of complex and often conflicting factors and fortuitous circumstances that, no wonder, the opinion is commonly held even amongst economists and sociologists that mathematical and physical methods of investigation have no place in the study and on a closer elucidation of social phenomenon, however, such a view is found to be untenable The history of science has shown that diverse fields which at one time appeared to be too complex for quantitative treatment to be possible, have yielded to the impact of the scientific method of investigation A preliminary study in all such cases is always the painstaking process of collection of data —experiment and observation For instance, who could have envisaged, say two centuries ago, the possibility of the kinetic theory of gases and the ground for this was paved by the work of investigators who devoted themselves to the experimental study of the properties of gases? The study of gases provides an illuminating parallel to social physics In either case one is not concerned with any prediction or description of the behaviour of an individual (molecule in one case and man in the other), but with those properties which arise primarily on account of the fact that we are dealing with a large collection of individuals The behaviour of individuals is chaotic and random and hence we are concerned with a large collection of them, these individual vagaries tend to cancel out and thus leads to the existence of properties of collections which can be studied without reference to knowledge or description of individual behaviour This is not to be understood as meaning that there are not properties of a collection for which a knowledge of individual behaviour is relevant It merely means that certain properties can possibly exist for a large collection which can be studied even though we are largely ignorant about individual behaviour It is obvious that properties which specifically depend on a knowledge of individual behaviour can only be fruitfully studied after one has investigated those simpler properties which can be described without reference to individual behaviour

In the case of social physics we are still at the stage where we must concentrate on discovering properties of social groups in an empirical way The theoretical interpretation and understanding of these properties will come much later Professor Stewart has in this connection drawn an interesting analogy between the study of contemporary social physics and that of celestial mechanics before the times of Kepler and Newton He writes "When celestial mechanics was being developed, in the 16th and 17th centuries, the order of advance was (1) the collection of quantitative observations (Tycho Brahe), (2) their condensation into empirical mathematical regularities (Kepler), and (3) theoretical interpretation of the latter (Newton) If there is to be social physics, its beginnings must follow the same standard pattern During recent years, social statisticians have published amazing amounts of numerical observations "

During recent years several pioneers, notably Pareto, Stewart, Lotka and others, have described many interesting and what appear to be fundamental empirical regularities in the fields of demography (the study of populations) and wealth distribution

We begin here with the *Rank-Size Rule* for cities which was first described by Prof G K Zipf of Harvard University in 1941 Take the cities of a country and arrange them in order of their population Let us take, for example, some leading cities of India and Pakistan The first twenty of them are listed in Table I The rank (denoted here by R) of the city is defined as its order number in the table in which the cities have been arranged serially according to their population, beginning with the one having the largest population. Thus for India, Calcutta has the rank 1, Bombay 2, Madras 3, and so on Let S_R (following the notation of Stewart) represent the population of a city of rank R Then the rank size rule asserts that

---

[1] Stewart, J. Q *Geographical Review*, 37, 461-485, 1947.

$$S_R = \frac{M}{R^n} \quad \text{where } M \text{ and } n \text{ are constants}$$

If R is the rank of a city of population S_R it means that there are R cities which have a population equal to or more than S_R

TABLE I
IMPORTANT CITIES OF INDIA AND PAKISTAN (1941 Census)

Rank R	City	Size S_R	Rank R	City	Size S_R
1	Calcutta	2 488 083	11	Lucknow	387 177
2	Bombay	1 489 883	12	Karachi	359 492
3	Madras	777 481	13	Nagpur	301 957
4	Hyderabad	739 159	14	Agra	84 149
5	Lahore	671 659	15	Benares	63 100
6	Ahmedabad	591 267	16	Allahabad	260 630
7	Delhi	5 1 849	17	Poona	258 197
8	Kanpur	487 324	18	Madura	239 144
9	Bangalore	406 760	19	Dacca	13 218
10	Amritsar	391 010	20	Sholapur	12 620

If we put R=1 in the above equation we have $M = S_1$ i e the constant M equals the population of the larger city It must be stated at once that in dealing with laws of the type mentioned above *we must guard on the one hand against giving the impression that any one of the empirical rules presented is at all exact and on the other against suggesting that the approximations are so rough as to be without profound interest and meaning* [1] As the rank size rule is not rigorous but only holds approximately a better fit between rank and population is obtained by identifying the constant M not with the population of the largest city but by adjusting it suitably to secure as good an agreement as possible over the whole range of R —this value will of course be roughly equal to S_1 Thus for instance in Figure I Log R is shown against Log S_R The points approximately lie on a straight line and we find from the slope and intercept of the straight lines the following value

$$n = 0\,78$$
$$M = 2\,4 \times 10^6$$

The value of M is practically the same as S_1

It is interesting to observe that the rank size rule does not hold if it is applied to cities forming an *arbitrary group* It holds only when the cities all belong to a region forming some sort of socio political unit For instance the rank size rule does not hold for the

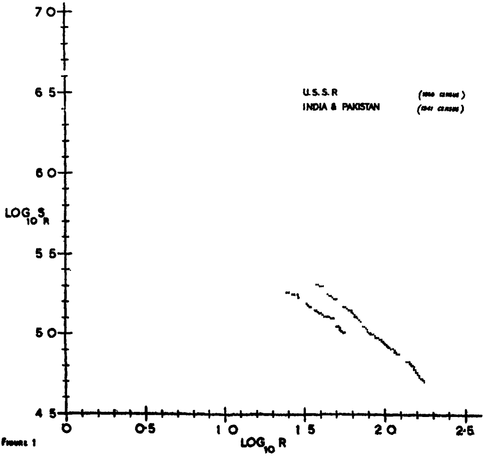


FIGURE 1

---

[1] Stewart, loc. cit pp 462-463

cities of Great Britain unless we consider them with all other European cities But for cities constituting a sort of socio political unit the rank-size rule applies remarkably well For instance in the case of the United States the rank size rule applied to all the sixteen census taken between 1790 and 1940 and in every case n equals very nearly unity (All cities are included with a population exceeding 2 500)[3]

For U S S R the R S_R values based on the census for 1939 are also shown in Figure 1[4] We have in this case

$$n=0\ 84$$

The value of M is very nearly S_1

The rank size rule applies not only to group of cities but to groups of diverse other entities

There is the Pareto s rule relating to the distribution of incomes in a country In this case let us suppose the individuals in a country to be all arranged serially according to the amount of their incomes the person with the largest income heading the list The rank R of a person will be his position in this list and S_R His Income If R is the rank of a person it means that there are R person with an income not less than S_R Pareto s rule states that in a country the number of persons R with an income equal to or more than S_R is given by

$$S = \frac{M}{R^n}$$

The values of n for different countries are given in Table II It is easy to show that larger values of n represent a more uniform distribution of incomes amongst the population

TABLE II

VALUES OF n FOR DIFFERENT COUNTRIES[5]

Great Britain (1932)	1 68
U S A (1934)	1 77
Germany	1 96
France	1 96
Japan (1930)	1 66
Russia (1924)	1 96
Australia (1935)	1 94
New Zealand (1934)	2 25
Holland	2 21
Hungary (1931)	1 70
Finland (1934)	2 03

Take another instance of the rank size rule this time the distribution of scientific papers among different authors[6] If we arrange authors serially according to the number of their published papers we find that the rank of an author is connected with the number of papers published by him in accordance with equation (1) with n=2

A further illustration is provided by the energy distribution in cosmic rays If R denotes the number of cosmic ray particles which reach the earth s surface for any time and with an energy equal to or greater than S_R then we have again equation (1) but in this case n has the value of 2[7]

It is not necessary to mention that we have no satisfactory explanation for the existence of the rank size rule for the cities or Pareto s rule for incomes or Lotka s rule for scientific papers It is worth knowing that so far we have not any explanation of the cosmic ray energy distribution rule referred to above

We will now turn to an interesting concept introduced by Stewart in the study of social physics namely the concept of population potential The potential of an electric charge at a distance d from it is defined by the ratio of the charge to distance In the case of gravitation the gravitational potential is defined as mass divided by distance Stewart found evidence *which suggested that the influence of people at a distance could be expressed by a similar coefficient namely* N/d N *being the number of people and* d *their distance away*[8] For this coefficient the name potential of population was at once suggested because of the physical analogies

As examples of influence reference may be made to (1) the drawing power of a college or school on given communities or States (enrollment in seasoned privately endowed national institutions tends to be proportionate to the population of a state divided by its distance from the campus) (2) attendance at the New York World s Fair in 1940 by States (proportionate to the population of a State divided by its distance from Flushing Long Island (3) circulation of the St Louis Star Times by counties (copies sold varied according to country population divided by distance from the city)

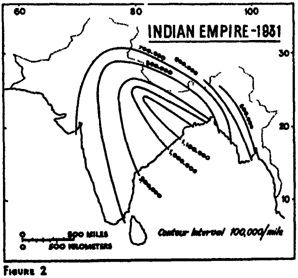


FIGURE 2

---

[3] Stewart, *loc cit* pp 462 463

[4] The population figures are taken from Turin The U S S R An Economic and Social Survey pp 198 199

[5] Collin Clark, Conditions of Economic Progress (Chapter XII) Macmillan & Co. (1940)

[6] Lotka, A J *Jour Washington Acad. Sci 16* 1926

[7] John G Wilson About Cosmic Rays (Sigma Introduction to Science, *14* pp 108

[8] Stewart, *loc cit* pp 471 472

On the basis of this definition, Stewart constructed maps of potential of population The value of the potential at any place is obtained by determining the values of N/d, where N is the number of persons at a distance d (from the place where the potential is to be determined) and summing this up for the total population of the country A potential map so constructed for India based on the 1931 census, is shown in Figure 2 (reproduced from Stewart's paper) Where the potential is high, that shows the region where the influence of the population is large and as social life depends upon the inter relation between individuals, places of high potential should correspond to places of high social activity The demographic potential should prove to be a quantity of great social significance

Another interesting empirical relation discovered by Stewart is one which connects the average area of cities in the United States with their population (1940 census) It asserts that

$$A = \frac{p^{\frac{4}{3}}}{350}$$

where A is the area in square miles and p the population The rule holds for all cities above the rural limit of 2 500

Earlier we referred to the kinetic theory of gases when discussing the possibilities of social physics Stewart (in the paper where he describes the area population relation) has applied to social physics the basic concepts of the kinetic theory of gases He even defines a human gas and finds that the human gas obeys an equation identical with the equation of a perfect gas *

---

* I am most thankful to Prof D S Kothari for his interest and help at every stage in the preparation of this paper

---

OZONE AND ITS COMMERCIAL APPLICATIONS

J R BASU MALLIK
REFRIGERATION AND AIR CONDITIONING SPECIALIST REFRIGERATORS INDIA LTD

INTRODUCTION

THOSE who go for a change to the seaside or the hills know that there is ozone in the air they breathe but very few know how the ozone is produced and why it is not possible to have ozone in the city Now a-days ozone can be inhaled even in the city at the touch of a switch One need not go to the seaside or the hills

Ozone is extensively used in coldstorages because of its germicidial properties and thus helping in preserving food for a long time Survey shows its increasing use in air conditioning In European countries ozone has been used extensively in cities drinking water Deaths due to cholera, typhoid and other contagious diseases have been reduced to a minimum because of the use of ozone in the treatment of drinking water Ozone is also being used in surgery and medicine Since its discovery in 1785 by Van Marum only the chemists were attracted to it But today, because of its commercial application, not only the chemists but also the physicists, electrical and mechanical engineers, bacteriologist and medical men are interested in its successful production and varied use of it

OZONE AND ITS PRODUCTION

Its chemical formula is O_3 whereas the formula for oxygen is O_2 Ozone is regarded as an allotropic modification of oxygen It is produced in nature by the electrical discharges during the thunderstorms or by the actions of sun rays on clouds and water of lakes and seas Oxygen is ionised by the passage of electric discharge, ultraviolet rays or high energy cosmic rays The ionised oxygen atom when clings to an ordinary oxygen molecule we get ozone By the manner of its formation it is expected that this extra atom of oxygen is liable to be affected by the presence of the particles surrounding it Ozone attacks organic matters readily During the process of oxidation it loses the extra oxygen and is reduced to ordinary oxygen It is produced in cities by the action of electric discharges or sun rays but it is readily decomposed into ordinary oxygen due to the presence of organic matters in cities' atmosphere So we do not have ozone in cities This fact has been clearly established by the observations at the seashore When wind blows from the city side there is little ozone but when the wind blows from the sea side the presence of it is definitely established

Artificially it is produced by the silent electric discharges of a high potential current between two cylinders with an air gap between the two

In commercial machines the air is sucked through a filter The filtered air is passed through a dehydrator because the moisture content affects the formation The filtered and dehydrated air then enters the generating plant which consists of an inner electrode and a glass dielectric 'Glass is chosen because of its great wearing quality, its high efficiency and its inability to absorb moisture It will not oxidize or blister" High voltage of the order of 6,000 to 12,000 volts (depending on the air gap) is applied with the help of a transformer and the ozone is produced as the current discharges The discharge takes place in the air gap between the electrode and the dielectric The discharge is of bluish colour and is generally known as a brush discharge The relative humidity and temperature affect the concentration of ozone produced With high humidity we have sparking instead of brush discharge Sparking produces high temperature and it is this high temperature that breaks down the ozone as soon as it is formed This condition takes place when the humidity of the air exceeds 50% There are a few types of ozoniser which would produce ozone successfully by handling air with a relative humidity as high as 90% The electrodes are made differently Instead of the usual smooth surface electrode an electrode that has a large number of points in direct contact with the dielectric is employed Since the points are directly in contact with the dielectric lower potential would be required for the brush discharge and the hazard of sparking would be lessened The disadvantage of the pointed electrode is that the discharge area is small compared to that of a smooth electrode The amount of ozone produced depends on the area The most outstanding advantage of smooth electrode with dehydrator is that it can be operated under all conditions and would generate a constant amount of ozone Inspite of the extra cost for the dehydrator it has been found economical to use an ozonator with a dehydrator Ozonators are rated in terms of grams of ozone per kilowatt hour

USE OF OZONE IN COLD STORES

Cold stores are generally heavily insulated to reduce the heat leak and thus to keep down the operating cost as well as the capital expenditure When we insulate against heat we exclude sunlight and all the benefits derived from it We all know that sun rays have germicidal effect It is absolutely necessary to replace the foul air of the room but it is excluded by the insulation The freshness of the room air exists till the oxygen of the air loses to oxidize the odour particles etc

The freshness of the room air can be maintained if outside air is introduced into the cold room but in that case the operating expenditure would be prohibitive On the other hand if something is not done to counteract the foul atmosphere of the cold stores then the benefits derived from the use of low temperature would be diminished and the damage would be done to the perishables

Ozone was tried and found to be extremely satisfactory The use of it in proper quantity would make the air fresh and sweet The extra cost for the ozone generator is justified for the gains derived The recommended concentrations to be maintained at for different products are given in table I The concentration is expressed in parts per million or ppm

TABLE I

OZONE CONCENTRATION RECOMMENDED FOR VARIOUS FOOD PRODUCTS

Butter	0 1 ppm	Onions	3 ppm
Lard	0 1	Citrus fruits	3
Cheese	0 2	Cannery fruits	1
Eggs	1 0	Apples	3
Fish	3 0	Grapes	2
Meat (fresh)	0	Potatoes	3
Meat (cured)	3 0	Beets	3
Carrots	3 0	Letuce	3
Celery	2 0	Cabbage	3

Another advantage derived from the use of ozone is the arrest of the formation of mold spores It has been found that in a clear and white washed cold store the use of ozone has completely stopped the formation of mold Mold thrives where the humidity is high In order to check the growth of mold the humidity in the cold stores is generally kept low but the low humidity has a deleterious effect on the produce The products shrink and lose the eye appeal and consequently the sales appeal The loss in weight for long storage is comparable and it is a financial loss to the dealer The remedy has been found in ozone It completely checks the growth of mold even when the humidity is as high as 90 to 95% within the cold store and the loss in weight of the produce

In the modern cold storage plants it is uneconomical to construct small rooms for the segregation of different products In the case of a large room where different products are stored effective steps must be taken to prevent the intermingling of the odours Odours as we all know are due to small particles of matter emanating from the parent substance Ozone which is a most powerful oxidizing agent at once attacks the organic compounds responsible for the odour and sterilises the atmosphere of the cold store It is entirely practical to store a large variety of vegetables in the same room without fear of contamination when ozone is used as an additional medium of air conditioning Onions potatoes, cabbage etc can be kept together for a considerable period with no unfavourable consequences when the air is properly ozonised

STERILIZATION & PURIFICATION OF DRINKING WATER

It is well known that polluted drinking water is the cause of diseases like typhoid cholera and other intestinal disorders The filtration system of the Calcutta Corporation cannot reduce the number of bacteria per c c to the desired level, so chlorine is added to the drinking water And yet the yearly toll taken by cholera, typhoid etc is staggering The author is of opinion that the treatment of water with ozone should be tried The purification of drinking water by ozone has been a success in a number of cities in Europe The author gives below some of the result of tests conducted in various cities of Europe

France "For years Paris could not produce typhoid free drinking water inspite of the fact that the most costly and extensive filtration works known were installed " At last it was decided to use ozone to sterilise the water Tests were conducted under the direct supervision of medical authorities, chemists and engineers Water from the Seine River was taken Before the test there were 127 to 444 bacteria per c c and after treatment with ozone there were only 2 bacteria per c c The ozonator used delivered 43 cubic meter of ozonized air per hour, with a concentration of 1 7 to 2 17 grams of ozone per cubic meter

During the second series of tests by the same authorities, water used was contaminated with 9860 bacteria per c c to this water were added—bacteria coli to the extent of 4,429,000 per 400 c c "After treating this highly contaminated water with ozone the samples tested showed only 2 bacteria per c c where before 9,860 bacteria were present Of the 4,429,000 coli bacteria per 400 c c present before ozone treatment, the microscope revealed only 2 bacteria coli per 10 c c Then tests were conducted with the water of river Marne The Marne river water contained 5195 bacteria per c c in addition to 740 bacteria coli per 400 c c and organic matter After treatment with ozone not a single bacteria coli was found even when the quantity of test water was as large as 2000 c c and only 7 bacteria per c c were under microscope

"These exhaustive tests convinced the medical as well as chemical authorities that the ozone treatment was not only perfectly safe, but that it produced practically sterile water under any and all conditions that might be encountered "

Germany Rigid examination and tests of drinking water were made throughout Germany Samples were collected from various cities and during different times of the year The samples collected were treated with ozone The treated samples were found to contain no more than 10 bacteria per c c Tests also revealed that all the bacteria of highly polluted water (20,000 to 60,000 bacteria per c c) were killed when ozone was 'admitted to the water in concentration of 0 9 to 1 8 gram per cubic meter of air " In Germany municipal authorities have introduced the ozonisation of drinking water to make it sterile

Russia The experiments conducted in Russia is still more astonishing In summer days when the demand for filtered water was heavy the municipal authorities of the city of Kieve in Russia admitted 40% of the unfiltered river water into the city supply lines and the water was treated with ozone The result was remarkable Before the treatment of water with ozone, 'typhoid claimed 164 7 per 10,000 population and 20 to 30 cholera cases were reported daily" but after the use of ozone "the typhoid and cholera epidemic disappeared entirely "

Other Countries Italy, Holland, Austria, Sweden and other European countries are using ozone apparatus in large numbers for sterilization of drinking water.

The United States Ozone has been used very little for the sterilization of drinking water but it has been used extensively in indoor swimming pool to keep it "clean and sanitary " Now-a-days the use of ozone in connection with the ventilating systems is gaining ground When it is used the supply of fresh air can be kept at a minimum The room air is recirculated after it is treated with ozone The more the recirculation the less the consumption of coal in winter season and smaller the refrigeration required in summers The use of ozone in the ventilating systems of schools has established definitely the benefits derived from it The number of cases of different sicknesses on the school children were collected and the results obtained in the case of a particular school is reproduced below

TABLE II

(Effect of Ozonised Air on various sicknesses of school children)

	Ozonised Air cases	Ordinary Air cases
Tonsilitis	13	57
Sore throat	24	60
Colds	40	64
Headache	9	66
Stomachache	0	25
Earache	1	15
Toothache	0	20
Indigestion	0	9
Fever	1	42
Lagrippe	0	6
Pneumonia	0	4

Ozonised air is being used in the operation theatre to help kill the bacteria The power of ozone to destory bacteria is definitely established and its use in the contagious disease hospitals is on the increase

OZONE TREATMENT OF DISEASE

The use of ozone in the treatment of diseases is in its infancy Researches are going on Many renowned physicians "treated various diseases with olive or codliver oil heavily charged with ozone By this method the oxygen content of olive and codliver oils used for treatment was increased to 8 53% In some cases the codliver oil used for treatment was charged with ozone until its gravity of 0 925 was increased to 1 000 Among the cases treated with this oil were tuberculosis, anemia, lung trouble, Bright's disease, abcesses, pneumonia and influenza."

COST OF OZONE GENERATION

In the use of ventilating systems it has been found that the saving in coal consumption in a year or two is more than the cost of ozone generator The cost of generating ozone is negligible In Germany the average cost of ozone treatment in water supply plants amounts to $ 0 0025 per cubic meter of water In France the cost of sterilising water is 0 0072 francs per cubic meter

'In the New York City the cost of electricity used for sterilizing 60,000 gallons of water for a swimming pool amounted to approximately 14 cents '

CONCLUSION

The author, here, has attempted to show the benefits derived in other countries by the use of ozone from the data available at his disposal What an appalling number of death occurs only in Calcutta due to cholera and typhoid and other contagious diseases Many of us believe that Calcutta's drinking water system is mainly responsible for it In the city of Kieve in Russia, we have seen how "the typhoid and cholera epidemic disappeared entirely" when the drinking water was sterilized with ozone It is not too much to expect from the Corporation of Calcutta and our National Government that they would try this method and benefit by the experiences of other countries

---

THE TAJIK-GALCHA ORIGIN OF PARSIS

SAPUR FAREDUN DESAI

PARSI PANCHAYET OFFICE BOMBAY

SCANTY knowledge of Persian Anthropology According to Luschan[5], (cited Modi [8a]) knowledge of anthropology of Persia is rather scanty He, however, gives two large ethnic groups—the Shute, the settled Tajik and Sunite, a nomadic Ihlat The latter being energetic and vigorous are all powerful They are the masters of land as also the Tajik, 'who are the descendants of old Persians and Medes ' Due to a contact of centuries there has been much miscegenation and it is difficult to find a purer type However the old type of Tajik has been preserved in the Parsi of India, the descendants of Persians who emigrated to India after the battle of Nehavand (641 A D) Luschan says they are of much purer form than among any true Persians In exactly similar terms Haddon[3] describes the Parsi and says he is descended from Tajik, Galcha and Wakhi Dr Luschan's article appeared in 1911 and Haddon's work 'Races of Man and their Distribution' was published in 1924 Perhaps the latter relied on the former or had access to the same materials However that may be, the Parsi of India is supposed to have been descended from Tajik

Meaning of Tajik In several works the word Tajik is supposed to denote an Arab origin, ancestry or descent Modi [8a] says that an Arab in Persia remained an Arab, if he did not intermarry, if he did, his descendants were called Tajik by the Persians A similar epithet is applied to a dog or a horse Simplified, the word then means a native of Persia, but of Arab extraction According to Seligman[9], (cited Modi, [8a]) the Arabs are a dolichocephalic or long-headed race with leptoprosopy, what is called a narrow face As such the nasal index may be anywhere between 55 and 70 Seligman however says that in Southern Arabia the population is mostly brachycephalic The northern Semites have essentially remained long headed but the southerners are mixed and mostly broad headed What is the reason? Modi [8b] has ably shown the historical and cultural contact of Persia with Arabia and the influence it bore on the physical characteristics of the Arab There was undoubtedly a kind of miscegenation between southern Arabia and Persia until the conquest of the latter by Mahomedans in the 7th Century

Arabian Anthropology According to Haddon[3], Arabia is the homeland of the Semites but there is evidence to show that there is ancient Hamitic population also Arabs of south west mountains are nearly white in skin with European features These are dolichocephals There is however in southern Arabia a brachycephalic population due to, as Haddon puts it, an unidentified migration of western brachycephals, either Pamiri or Armenoid Now what is this Pamiri or Armenoid stock? We shall see that presently

Modi[8b] refers to incense trade of Arabia with neighbouring and distant countries, especially Persia, Mesopotamia, India and Africa It is supposed that this might have influenced the brachycephaly of South Arabia I am not inclined to give more weight to this than what is normally possible If the Arabs went to trade in distant countries they could have left their progeny in ports of call but I fail to understand how they could have been themselves affected If at all it should be the country, where he leaves his progeny, which should be affected I would therefore rule out this possibility unless it can be proved that Arabs brought with them women folk of contact countries

Physical types of Persia Haddon says that 'apart from intrusive Kurds, Arabs, Armenians and smaller groups there are two large ethnical groups in Persia, the settled Tajik, the old type which is preserved in the Parsi who migrated to India in A D 640* and the Persians ' The Tajik of the plains is more mixed than the Tajik of the hills, who is known as Galcha The incursionists of the Eurasian Steppes who became known in history as the Medes and Persians were supposed to be protonordics with lighter complexions but it is surmised that Semitic (Arab) and Turki migrations and incursions have been responsible for modification of the Persian type Haddon gives the following two physical types of Persia —

1 The slender dolichocephalic Farsi about Persepolis, fair skinned and of proto Nordic origin

2 The Lori, a taller, darker, black haired, very dolichocephalic population

From this it would appear that today Persia is largely dolichocephalic Who was it then that modified the south Arabian population into brachycephals? Let us see

Ethnic Make up of Ancient Iranians The *Gathas* which should contain authentic information are silent on the 'national or ethnic make up of the Iranians They were written in an age of embittered religious and economic struggles and as such the national ideal held a second place The population was however not a mere conglomeration of Mazdayasnans but it belonged to one tribe or one nation with a common descent, *viz*, Aryans Geiger[3] who has treated the subject extensively finds it difficult to assess the physical characteristics of the Iranians He however thinks the men were of medium, often of high stature, and were strong built with broad and well developed chests Female formation of body was slender and supple, colour of skin brighter and the skin delicate, particularly those parts protected against the sun Men and women had large shining eyes Men had luxuriant beard growth with dark brown hair Light brown and red hair were not uncommon Brachycephalic structure of the skull was general with an oval face Nose, mouth, forehead, hands and feet were well shaped

Far flung Tajiks In this the most important point is the brachycephaly of the Eastern Iranians in ancient times A common term applied to these people as opposed to a Turk or Tatar was Tajik Almost all the settled population was called Tajik, while the nomadic population was called Sart ' Geiger says that while the word Sart is of historical import, the word Tajik is of ethnological import During the last century these Tajik were found to have been spread far and away from their place of origin In Afghanistan the Tajiks can be found in Kabul Kandahar, Herat and Balkh, in Kohistan, Loghar Valley and Seistan They are also found in Baluchistan distinguished by the use of Persian language

In the country of the Amu Daria and Sir Daria, there are three types of Tajiks, *viz*, the native Iranians, the Persian colonists and the descendants of Persian slaves The indigenous Tajiks as a general rule have brown hair and beards, also fair and red hair Khanikoff[4] describes these people as tall with black hair and beards, large, dark eyes, well formed nose, mouth rather large with forehead broader and body heavier than Western Iranians

The Tajiks of Pamir are described by Shaw[10] as a handsome race having a high forehead, large expressive eyes with dark eyelashes, delicately formed nose, short upper lip and rosy complexion Men have generally large and flowing beards with often a brown but sometimes a reddish tinge They differ from high caste men of northern India in being more stoutly built and in having fuller faces

According to Ujfalvy[12] the Tajiks of the mountain have a more independent and noble character than the Tajiks of the plains Their morphological characteristics and their customs make them akin to old Mazdayasnans of whom they appear to be genuine descendants The mountain Tajiks are collectively called Galchas Being isolated they are less mixed than the Tajiks

According to Tomaschek[11], the Galchas are individually handsome with brown, occasionally red and flaxen hair Their head form is brachycephalic with considerable skull capacity which rarely occurs prominently in a pure Tajik They are found in the valleys near Ferghana, the Zerafshan Yaghnob and the Oxus In the eastern plateau of Pamir, they are to be found beyond the Neza tash ridge, in the district of Sirikul Their language is more akin to eastern Iranian than to modern Persian These are the people who were once Zoroastrians and who had receded into fastnesses after the Arab conquest They preserved the old culture and religious tenets for a very long time they would not blow out their light and would expose their dead

From the above it would appear the Tajiks and Galchas are spread far and wide, away from their original home, Iran, and their only relics still observing Mazdayasni Jarthosti religion in its pristinity are now only the Parsis of India According to *Encyclopaedia Brittanica* (14th Edition, Vol XXI) the Tajiks are 'a subject race of Afghanistan, but the original Persian possessors of the soil, who still speak their mother tongue The word as now used properly means Arab and was applied to those communities where Arabs settled at the time of the first Arab conquest '

True Tajik Derivation In Tartary the word 'Taujeck is used to denote a man of civil occupation (Malcolm,[7]) as against a Tatar soldier but according to Zoroastrian literature[18] 'Tajik' has a very interesting origin The first kings of Iran were the Peshdadians, if we ignore the kings of Mahabad The first king of the Peshdadian dynasty was Haoshyanga or Hoshang*, who had a brother named Taz They were both descended from a common Iranian father named Fravāk Taz left Persia and migrated to Arabia where his descendants were called Taziks Thus while Hoshang became the progenitor of Iranian stock his brother Taz became the progenitor of Arabian stock Both these stocks may thus be deemed collateral having descended from a common stem Although history does not support us we may perhaps conclude that Taz might have had quarrel with his brother Hoshang on his becoming a king and he might have been forced to leave Iran Under these circumstances he might have migrated to Arabia not alone but perhaps with his followers including women In one place[13] we do find that his sister Tazāk went with him and from this pair arose the Arab race just as from Hoshang and Guzak arose the Iranian race We d do not know what kind of people they met there but it stands to reason that Taz and his followers must have mixed with the original population who later came to be known as Tazik after Taz These Taziks must have back crossed with Iranians and were known in Iran as Tazik Zoroastrians as distinct from Iranian Zoroastrians Maçoudi (cited Modi [8b]) says that there were some Arabs who claimed Zoroastrian descent In Sarosh Yasht Nirang (Yesn Ha 57) they are referred to as Tāzikān i Basté Kustiān

---

*According to competent opinion the Parsis came to India in the middle of the 8th Century

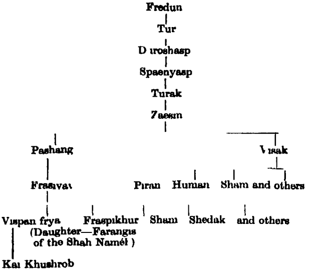
*According to Malcolm, the first king of the Peshdadians was Kaiomurs, possibly Gayomard

Was Zohāk Semitic or Syrian Prince In Iran these Tazikan must have been in plenty as can be seen from the fact that the dynasty of Zohak or Azi or Dahāka ruled over Iran for 1000 years and this Zohak was a descendant of Taz Yima or Jamshed whom he overthrew was a distant collateral Iranian cousin of his

Even if we consider Dahāk s mother s ancestry it would appear she had some Iranian ancestors and the name Pairi Urwaesm of one of the ancestors is highly suggestive of Avestan influence

Malcolm[7] says that according to some historians Zohak was an Arabian Prince but descended from Kaiomurs while others call him a Syrian Prince descended from Shedad Some even call him the Nimrod of the Bible In spite of all these things we are inclined to believe that Zohak was not really a semitic prince although he came from Arabia much less a Syrian and his dynasty was not a foreign dynasty but a dynasty which had originated from a common Iranian stem Firdousi s Book of Kings shows that Zohak was a very cruel king and being an all powerful despot he was merely tolerated by his half cousins of Iran During the thousand years of the Zohak dynasty there must have been many migrations to and from Arabia until Faridun Athawian rose to expel the despotic dynasty some ten generations after Vivanghān the father of Jamshed or Yima

Who were Turanians Fredun had three sons Selm Tur and Erach While Fredun divided his kingdom he gave that portion of his kingdom to Tur which afterwards came to be known as Turan inhabitants whereof though having kinship of blood with Iran, came to be the adversaries of Iranians A notable counterpart of Zohak or Azi Dahak in this dynasty was Frangrasyana or Frasiyav or Afrasiab This can be seen from the following pedigree tree —



Common Ancestry of Taziks and Turanians Thus Taziks and Turanians both stemmed out of a common ancestor and although there were inimical incursions of one country against another their blood had the same origin While the Tazik had a prototype in Zohak the Turanian had a prototype in Afrasiab But the generality of the populace had much in common with their Iranian progenitors It is perhaps because of this that in the Farvardian Yasht (Yt XIII 143 44) the good souls of the Turanian dead have been invoked along with Iranians and as we have seen above the Tazik Basté Kustians have been referred to in the Sarosh Yasht Nirang

Persian Quality of Acculturisation Modi[8b] in his paper entitled The Physical Character of the Arabs Their Relations with Ancient Persians gives a very succinct review of historic relationship between Persia and Western Arabia While Zohak and Farédun may belong to prehistoric times the later Iranians like the Achaemenians and Sassanians fall within historic times The Medo Persians were dolichocephalic but being small in number they could not transmit their characteristic to the Achaemenians The result was they were themselves absorbed into Persian brachycephaly There is something within the soil of Persia that whatever the outside culture it would ultimately get absorbed into the local culture The Parthians who had nothing ethnologically common with the rest of the country were ultimately assimilated in the melting pot of national characterisation and were eliminated as an ethnic influence Persia has withstood all foreign attempts at deculturisation and has succeeded in acculturising all its invaders Even the 7th century invaders in point of culture and language custom and tradition, have completely been absorbed into Persian life Quoting Prof Darmesteter, a famous scholar on Zoroastrianism, Modi[8b] says, "In reality, the Islam of Persia is not Islam It is the old religion of Persia, encircled with Musulman formulae " This main trait seems to have been handed down to the Parsis of today who, even after 1200 years of stay in India, have been able to largely preserve their old physical characteristics

Racial Classification of Asiatic Leucoderms In the beginning we have referred to Haddon who says that Southern Arabia seems to have received its brachycephaly from Pamiri or Armenian stocks Who were, then these Pamiris or Armenians? Had they any thing in common with ancient Persians and with the Parsis of today ? According to Haddon[3] Asiatic Leucoderms are divided into two main groups by head form, *viz* ,

I Dolicho mesocephals
II Brachycephals

Brachycephals are again divided into two sub groups, *viz* ,

1 Georgianus
2 Armeno Pamiriensis

The sub group Armeno-Pamiriensis comprises

a. The *Galcha Tajik* Wakhi (Pamirs and Kashgaria)
b Armenians, brachycephalic Kurds Lasi Betash Ansariyeh Kyzylbash etc

The two distinct groups herein are

1 Pamiri or Iranian (Galcha, Tajik Wakhi) strong brachycephalic with cephalic Index 85 leptorrhine nasal index 66 8 to 71 3 and medium to tall in stature 1 669 to 1 689 m

2 Armenian (or Assyrian)—very high foreheads a vertical occiput Cephalic Index 85 to 89 5 an extemely prominent nose and slightly taller

South Arabian Brachycephaly due to Persian influence Here then is the clue to the South Arabian brachycephaly The Pamiri or Iranian stock has been responsible for the result and history supports this view in so far as it was Taz and his followers, and consequently their descendants who have left this indelible mark in South Arabia Modi in his paper referred to above says

> Their association even in a Zoroastrian prayer shows that some of the Arabs had come into much closer contact with the ancient Persians So there is no wonder if their physical characteristics were hereby influenced to some extent

Whilst there were intermarriages between Arabian and ancient Persian royalty like the three daughters of Pat-Khushrob, an Arab king marrying the three sons of Fredun referred to above, there must have been many intermarriages in the general population There were few barriers of religion between 4000 5000 B C and Pat-Khushrob is supposed to have given up fish worship in favour of fire worship However in later times, notably the Sassanian, there were Zoroastrian governors in South Arabia One such governor named Badhan soon after the death of Khushru Parviz (Chosroes II), the grandson of Noshirwan the Just, embraced Islam and became independent Many others must have done so thus adding their mite to the ethnic make up of the South Arabian populace

In Iran proper the name Tazik, though suggestive of miscegenation, was not at all really so from the ethonological point of view As we can see from above it was merely an errant branch of Iranians meeting again on homeland and back crossing with its cousins I am therefore inclined to take the view that these Taziks were actually not Arabs converted to Zoroastrianism—though there is nothing to doubt that in ancient Iran some Arabs of the pre Mahomedan era must have been proselytised—but that they were descendants of Iranians themselves returning from Arabia to homeland Perhaps this name was also given by Persians to Arab descendants out of Iranian wives as stated in the previous part of this paper

At one time the late Mr Muncherji P Khareghat, the oriental scholar, had told the writer in one of his lucid discourses that he believed the Tajik was of Iranian and not of Arabian origin as is supposed to be He said he had expressed that opinion in the early twenties before the commission which had interviewed him in the Bella Case of Rangoon

Comparison of Physical characteristics of the Tajik and Modern Parsi The physical characteristics of the Tazik and Galcha stocks have been given above on the authority of Haddon In a recent anthropometric study Majumdar[6] comes to practically the same results For a quick comparison I give the characteristics as below

According to Haddon		According to Majumdar	
C I	85	C I	82 16
N I	66 8 to 71 3	N I	65 90
Stature	1 669 to 1 689 m or 65″—66	Stature	167 73 cm or 67″ app
Strong Brachycephaly		Brachycephaly	

The above comparison shows that except for a fall from marked or strong brachycephaly to just brachycephaly the Parsis have preserved their Iranian characteristics, except in the case of stature which is slightly taller Majumdar has deduced his results from a small sample of Parsis I have myself worked out the arithmetic mean of heights of 162 insured Parsis and it comes to 67 inches with average weight 146 6 lbs , average chest measurement (percent of weight) 54 4 and body build index 32 6 (Desai, [1])

CONCLUSION

From the above results I am inclined to conclude that the modern Parsis definitely derive their ancestry from the Tajik and Galcha stocks of ancient Iran who were more Iranian than Arabian and with negligible differences have remained true to type I am not inclined to believe that only Arabs settling in Persia and marrying Iranian wives had descendants who were called Tajiks On the testimony of Geiger, although Tajik was the word used for denoting the settled population, it actually had an ethnological import and there must have been some such ethnic group of uniform measurements so as to mark it out from the rest of the aboriginal and nomadic population This was so in days of antiquity In historical times Persia being nearer home sent out more recruits to South Arabia who form the brachycephalous population of that place The theory of incense route bringing Arabians in contact with Mesopotamia India and Africa and thus modifying their head form as suggested by some writers may perhaps be discredited If male Arabs went out to trade with foreign countries they would leave their trace in ports of call and not bring it with them, unless they systematically brought foreign women to Arabia If any thing it is the Arab who should affect the contact nation and not be affected himself Therefore it was definitely Persia which brought about the brachycephaly of South Arabia and they were the Tajik or Galcha ancestors of modern Parsis *

---

*My sincere gratitude is due to Drs Maneckji B Davar and Jamshedji M Unvala, both noted scholars on Zoroastrianism They have pointed out to me that according to the Kisseh Sanjan the first Parsis came to India from Khorassan and that they were the descendants of the royalty and noblemen of the Sassanian Court who had retired to Tabaristan after their defeat in 641 A D had maintained their freedom and had their own form of governance and coinage While I have not the slightest intention to discredit the Kisseh Sanjan, I would here say that there is nothing to disprove historically or scientifically that the ethnic make up of the Khorassanis was brachycephalous with its attendant indices

REFERENCES

[1] Desai Sapur Faredun A Community at the Cross Road

[2] Geiger Wilhelm Civilization of the Eastern Iranians in Ancient Times, Vol I Henry Frowde London Translated from the German by D D P Sanjana 1885

[3] Haddon A C The Races of Man and Their Distribution Cambridge University Press 1924

Khanikoff Mémoire Sur l ethnographie de la Perse cited W Geiger q v

[5] Luschan Felix V The Early Inhabitants of Western Asia *Jour Royal Anthropological Inst* Great Britain and Ireland Vol XLI 1911

[6] Majumdar D N Race Elements in Cultural Gujarat 1947

[7] Malcolm John History of Persia Vols I & II John Murray London 1829

[8a] Modi Jivanji Jamshedji The Persian Origin of the Kurds and the Tajiks Anthropological Papers Part II 1912

[8b] Modi Jivanji Jamshedji The Physical Character of the Arabs Their Relations with Ancient Persians Anthropological Papers Part III 1919

[9] Seligman C G The Physical Characters of the Arabs *Jour Royal Anthropological Inst* Great Britain and Ireland Vol XLVII 1917

[10] Shaw Reise cited W Geiger q v

Tomaschek Pamir dialekte cited W Geiger q v

[12] Ujfalvy Exped Scient Vol II cited W Geiger q v

[13] Zoroastrian Literature Bundahesh Chithradad Dinkard etc See Sacred Books of the East Vols V VII XXXVII XLVII etc

---

BACTERIAL PLANT CANCERS

U N MOHANTY

MYCOLOGIST DEPARTMENT OF AGRICULTURE ORISSA CUTTACK

THERE are certain plant parasitic bacteria which cause various abnormal growths manifested in the form of fasciation, root-formation and galls or tumours in the plants The nodule bacterium which is not considered as a parasite, also induces a sort of abnormal growth by forming nodules on the roots of leguminous plants Of all these bacteria, the gall forming organism, ***Bacterium tumefaciens*** Smith & Townsend is very interesting, as it stimulates the plant cells to divide and multiply, with a result that a gall or tumour is formed on the plant surface Sometimes, huge galls are thus produced in nature and very frequently, bacteria are missing from these gall tissues But, even in absence of bacteria, the plant cells continue to multiply as a result of initial stimulation and the galls grow in size Ordinarily, it is seen that the bacterium infects the superficial layers of the plant tissues and continues to act from there. By anatomical studies it is also known that in the infected region, certain cells in the deeper layers become meristematic and they continue to divide and multiply and to produce a mass of undifferentiated cells As a result the bacteria-infected layer is gradually pushed out and in larger and older galls these outer layers are finally cast off Hence in older galls, bacteria may be absent but even in spite of this the stimulated cells retain their meristematic activities and continue to add to the size of the gall This is a point to show that bacterium merely acts as a stimulus in the beginning and sets the ball rolling Moreover, in some plants secondary galls are also produced at a distance above the primary ones and the former are invariably bacteria-free It is presumed that these galls are produced as the result of certain stimuli which are transmitted from the original infected area More interesting is the point, that when the bacteria free tissues from these secondary galls are grafted to a healthy plant, they also induce the formation of new galls. Therefore, once the cells are made to divide and multiply under the influence of bacterial attack, this changed cell behaviour can be transferred from one place to another without any further assistance of the bacteria. Evidently, the course of this plant disease is very much similar to that of human cancer. In case of the latter, the causal organism, if any, is of course unknown but the cells acquire the similar property of continued growth and multiplication as those in the plant galls. As a bacterium is now known to be responsible for plant galls, naturally, it has been a matter of unusual interest both for the Plant Pathologists and for Medical Doctors to study the action of this bacterium. Consequently, a vast body of literature has accummulated on the behaviour of crown gall organism *B tumefaciens*, and the possible importance of a variety of chemical substances produced by bacteria has been examined and their action on plant tissues has been studied. The results on these lines have been rather negative, but at the same time considerable advances have been made in our knowledge. The most recent explanation regarding the gall formation in plants is the possible relationship of plant growth substances or auxins and around this a large body of literature has grown up.

The idea that a hormone or a growth substance is concerned with the normal growth and development of a plant is well known. These plant hormones or auxins control the bud development, stimulate the meristematic activity of cells, initiate the root formation and cause epinasty on the leaves. Various synthetic substances are now being manufactured which also behave similarly as auxins and go by the general name of heteroauxins. In the crown gall, apart from the cambial activity resulting in a gall, adventitious root formation was noted by Smith Brown & Townsend (1911). In Paris Daisy and Balsam plants, Brown (1929) also reported that besides the gall formation, the inoculations with *Bacterium tumefaciens* resulted in the formation of adventitious roots. These phenomena have also been reported by various other workers. Locke, Riker & Dugger (1937, 1938) also adduced evidences that crown gall organism could cause epinasty of the leaves. So, during the infections by *B tumefaciens*, all these growth phenomena, such as stimulated cambial activity adventitious root formation and epinasty of the leaves are noticed and these can also happen under the influence of auxins or the synthetic growth substances known as heteroauxins. Kraus, Brown & Hammer (1936) and Brown (1937) showed that indole 3 acetic acid stimulates cambial activity and produces galls on the tissues. Root formation and leaf epinasty under the application of heteroauxin are also well known. Thus from the symptoms, it is highly suggestive that bacterial gall formation may take place under the influence of high auxin concentration and as such, investigations were required to assay the auxin concentrations in the gall tissues. Link & Eggers (1941) used the usual ether extraction method in isolating auxins from the gall tissue and conducted the *Avena* curvature test to determine the concentration of the auxins. It was observed that the amount of growth substances in the gall tissues was very much higher than that found in other parts of the plant. Thus the presence of higher concentrations of growth substances in the bacterial gall tissues is now certain. Although the natural plant auxins such as auxin *a* and auxin *b* could not be obtained in a pure form and the experiments could not be carried out with these natural substances, indole 3 acetic acid a heteroauxin was used in most of the experiments designed for comparing the behaviour of *B tumefaciens*. Lately, indole 3 acetic acid has been isolated from plant tissues (Haagen Smit, Leech & Bergen, 1941) and it is now taken as one of the natural auxins. Therefore, the behaviour of *B tumefaciens* which parallels with that of high concentrations of indole 3 acetic acid in plants, led to the belief that growth substances are responsible for gall formation.

Brown & Gardner (1936) were of the opinion that neoplastic growth in plants was not due to the direct action of *B tumefaciens*, but to the products of its metabolism. They suggested that a growth substance could be isolated from the cultures of bacteria. A number of other workers also showed that the filtrates of bacterial culture behaved in the same manner as any of the auxins or heteroauxins would normally do in plants. In fact, by chemical tests Link, Wilcox and Link (1937) demonstrated the presence of indole 3 acetic acid in broth cultures of *B tumefaciens*. Similarly other authors have also claimed that *B tumefaciens* produced growth substances in culture and possibly it might be doing so in the plant tissues.

Brown & Gardner (1936) suggested that these growth substances might travel inside the plant tissues and cause secondary galls elsewhere than the place of original infection. Experiments have been made on diverse lines to suggest the possibility of movement of certain substances from the gall tissue. In this connection, the presence of living bacteria in primary and secondary galls has been critically examined, so that this may lead to some clue. Smith, Brown & McCulloch (1912) were unable to isolate *B tumefaciens* from the secondary galls in Paris Daisy. This was confirmed by Braun & White (1943) in the Sunflower plants. Several other investigators also came to similar conclusions. White & Braun (1942), by using these bacteria free tissues from secondary tumours were able to produce galls in healthy tissues. By their tissue culture method with which a part of the living tissues can be made to live and grow in culture, they removed some tissues from these bacteria free secondary galls and observed that the tissues grew up into large sized galls. Thus the infectious nature of the gall tissues can not only travel in the same plant and from one cell to another but also from one plant to another. Now knowing that the secondary galls are bacteria-free and they can also transmit the neoplastic growth of the tissues, a considerable interest was centred round the origin and behaviour of these secondary galls It was suggested that growth substance produced in the infected area, travels inside the plants and accumulates at a place and forms a secondary gall By some special techniques, some virulent and avirulent (attenuated) strains of *B tumefaciens* could be obtained The former, when inoculated into plant tissues, produced strong galls whereas the latter produced a slight swelling Locke, Riker & Duggar (1938) showed that when a virulent strain was inoculated at a distance above the attenuated strain, the latter developed a strong gall Thus they suggested that the virulent strain which was capable of producing growth substance, allowed the auxins to travel downwards to the attenuated strain and helped it in the formation of normal galls Riker (1940), showed that if instead of inoculating the virulent strain up above the stem, it is inoculated below the attenuated strain, the virulent strain exerted no such influence on the latter This is quite in agreement with the polar movement of the auxins, which can travel only downwards Hence the association of auxins in the gall development became an attractive hypothesis

The examination of primary galls occurring in nature or arising out of artificial inoculation has also yielded interesting results Jensen (1918), De Ropp 1947), failed to isolate bacteria from naturally occurring galls in the beets It was definite that those galls were formed due to the action of bacteria and the tissues possessed the property of inducing fresh galls when they came in contact with the healthy tissues Thus he concluded that in older galls the bacteria must be dying off In the subsequent season, he also extended his experiments on the tumours in Mangels and Sugar beets and essentially came to the same conclusions Recently De Ropp (1947) also carried out similar tests on a number of host plants such as tomato, tobacco, and sun flower By artificial inoculations he induced gall formations in these plants and later, tried to isolate the bacteria from these tissues In his every test, he could invariably isolate *B tumefaciens* from the gall tissues of tomato and tobacco, whereas, he failed to isolate the bacteria from the sunflower Thus while he agreed that the bacteria die out in older galls he also suggested further that the position may vary along with the host plant the bacteria dying more quickly in one and less quickly in another Also in tomato and tobacco, he could always isolate *B tumefaciens* from the internode tissues on either side of the gall, up to a certain distance This suggested that bacteria could travel to a certain distance inside the plants

However, to sum up, the investigations have led to the following broad conclusions

1 Crown gall in plants is caused by *Bacterium tumefaciens*

2 The bacteria usually die out in older galls But, the tissues continue to grow, multiply and add to the size of the gall

3 Bacteria-free secondary galls are frequently formed near the primary galls in plants.

4 Tissues from these secondary galls, if grafted to healthy plants can also produce fresh galls

5 The symptoms produced by crown gall organism are very much similar to those produced by the higher concentrations of heteroauxins

6 There is a higher concentration of auxin in the gall tissues of the host plant

7 The bacteria produce heteroauxins in culture and the bacteria-free culture extracts of *B tumefaciens* also induce galls in the plants

Thus it was very tempting to ascribe that *B tumefaciens* produces growth substance and the accumulation of this substance results in the formation of galls in higher plants But further researches have brought to light some conflicting evidences, whereby it is doubted, if auxin produced by bacteria is alone responsible for the gall formation in plants

Locke, Riker & Duggar (1938, 1939a) first reported that both virulent and attenuated strains of *B tumefaciens*, produced approximately equal amounts of growth substances in culture Actions of these strains were quite different on the host, one producing a large and normal sized gall and the other producing a slight swelling Grieve (1940) also came to similar conclusions Further, he reported that certain other plant parasitic bacteria, namely, *Xanthomonas solanacearum* (Smith) Dowson, *Corynebacterium michiganense* (Smith) Jensen, and *Corynebacterium flaccumfaciens* (Hedges) Dowson, did not induce gall formation, and yet, they produced heteroauxins in culture Moreover, in these bacteria as well, both pathogenic and non pathogenic strains, produced similar amounts of growth substances in culture *B tumefaciens* and *C flaccumfaciens* while producing heteroauxins in culture failed to induce similar growth responses on the same host Both are known to attack the French Bean in which galls are formed under the external application of heteroauxins and as well as, of the bacteria free culture extracts of *B tumefaciens* On this host, *B tumefaciens* always produced the galls whereas *C flaccumfaciens* failed to do so These variations can not be explained, if the hypothesis that (bacterially produced) heteroauxin produced by bacteria is alone responsible for the gall formation in the plants The results of further investigations also do not find in favour of the proposed hypothesis It was observed that indole 3 acetic acid (heteroauxin) even though applied in high concentrations was relatively ineffective as compared with the extracts of a virulent strain and thus also, failed to help an attenuated strain for producing a normal gall Moreover, different host plants also responded differently to the application of heteroauxins, whereas they all produced galls under the infection of *B tumefaciens* Furthermore, in the gall tissue the amount of growth substance which are evidently produced by relatively a few bacteria, can only be produced by very large numbers of bacteria in culture Therefore, the production of growth substances by bacteria can never be the only factor explaining gall formation in plants As suggested by Leonian (1937) and later by Link, Wilcox and Link (1937), the growth substances obtained in the gall tissues are largely due to the stimulation of the host cells which affects the normal production and transport of the auxins and make these accumulate in the gall tissues Later on Kocke, Riker & Duggar (1938, 1939b) also agreed with Leonian in suggesting that the accumulated auxins are the products of host cells and most likely not the products of bacterial metabolism, Link, Wilcox & Link (1937) and Link & Eggers (1941) incline to the view that the gall formation is due to the growth substances produced both by the parasite and the host Thus the association of auxin in the formation of plant galls cannot be discarded and very possibly, some other factor or factors operate along with the auxins The accumulation of auxin may be as much a result as the gall formation occurred under the influence of bacteria and it is a necessary accompaniment with the cell proliferation and gall formation However, it remains open, why there is such a disturbance in the auxin concentration Further investigations have got to be made on this matter and it is to be ascertained what those other factors are that lead to the auxin accumulation and consequent growth phenomena Some authors have thought of the possible role of vitamins, which behave as growth factors in plants For instance, Bonner (1938) recognises that thiamin is a root growth factor in the normal plants Therefore, the action of various vitamins such as biotin, flavin and pantothenic acid together with thiamin has been studied by Henry, Riker & Duggar (1942) So far, the studies have indicated that vitamin B has no relationship with the development of crown gall

Another explanation may be the association of food factor It is now recognised that although auxin is required for plant growth and development, this alone is inoperative without a second factor, namely, food Schneider (1938) has shown that along with the auxins sugar is necessary for the growth of *Avena* It is quite possible that crown gall organism might be interfering with this food factor in some way or the other so that the normal balance is disturbed Feeding of plants with certain food substances may also result in abnormality Virtanen & Linkola (1946) have shown that feeding of pea plants with α alanine leads to curious branching and to other growth abnormalities Therefore, one does not know how far these bacteria might be affecting the food substances in the cells Since auxin action is also bound up with the food substances, the food auxin complex may be operating together at the same time and result in auxin accumulation No doubt, it seems to be a very useful line of enquiry to know the behaviour of *B tumefaciens* in the context of food factor Therefore, as can be judged from all these evidences, we are still away from a correct solution of the crown gall development in plants

Another growth phenomenon, which is very much similar to crown gall development can also occur as the result of infection by the Legume nodule bacteria Investigations as to the mechanism of their action have not been done so extensively as they have been done in case of the crown gall organism, *B tumefaciens* However, certain comparable results have been obtained in case of the *Rhizobium* and it is interesting to review these in the light of auxin theory

Thornton (1936) showed that in Lucerne, before the infection by *Rhizobium* the root hairs got coiled and the subsequent bacterial entry took place only in the deformed regions Further, Thornton & Rudorf (1936) stated that in a nodule there is a cap of meristematic cells which continue to divide, multiply and add to the size of the nodule Hiltner (1900) observed that filtered extracts of bacterial culture could produce similar deformations on the roots as are caused by bacteria Molliard (1912) also noted that sterile culture extracts of *Rhizobium* could bring about further abnormalities such as growth inhibition increased cell division, deformation and enlargement of cortical cells Therefore, he concluded that *Rhizobium* produced some active principles in the culture and these might lead to the observed growth phenomena Thornton (1936) also came to similar conclusions

Thimann (1936 1939) postulated the growth factor hypothesis for explaining the mechanism of nodule formation The observations which led him to the formulation of this hypothesis were as follows 1 There was a high concentration of auxin in the nodules, 2 Application of heteroauxins to lateral roots resulted in growth inhibition, swelling of the cells and increased cambial activity 3 Indole 3 acetic acid was produced in bacterial culture containing tryptophane Thus his conclusions were that the bacterial culture produced indole 3 acetic acid inside the infected tissues Further, in explaining the course of nodule formation he states that in the beginning when the auxin concentration is low, this growth substance leads to the enlargement of the cells and to the initiation of cambial activity But in course of time, on account of continued auxin production, the concentration becomes higher and the elongation of the root hairs is inhibited The continued swelling finally results in the formation of a nodule

Looking superficially, this explanation seems quite attractive, but as in the case of crown gall there are various difficulties before this hypothesis can receive the general approval It is known that heteroauxins can bring about root curling in the same way as the bacteria before they effect their entry into the plants Link (1937), Chen (1938), Thimann (1939) and Georgi & Beguin (1939) observed that various species of nodule bacteria produce indole 3 acetic acid in culture But Chen (1938) showed that both effective and ineffective strains of nodule bacteria could produce approximately the same amounts of heteroauxins, in culture Further, Georgi & Beguin (1939) stated that in some cases, the ineffective strains produced even greater amounts of growth substances *B radiobacter* which occurs as a usual contaminant in the nodules, also formed heteroauxins in culture This organism has no connection with the infection of the roots and the subsequent development of the nodules Chen Nicol & Thornton (1940) explained that the initiation of the cambial activity was due to the growth substance produced by bacteria but in case of ineffective strains, the growth of bacteria was normally arrested inside the host cells and as a result there is less of growth substance production in the host cells Hence the responses are different the effective strains producing the normal nodules and the ineffective ones failing to do so

Obviously there is secretion of some active chemical substances by the nodule bacteria and these may be responsible for the growth reactions in the plants But whether it is auxin and auxin alone is yet to be confirmed However the balance of evidence suggests that auxin may be one of the factors but we are still away from a correct explanation regarding these abnormal growths in plants

REFERENCES

Bonner J *Amer J Bot* 25 543 549 1938

Braun A C & White P R *Phytopathology* 3 85 100 1943

Brown N *J Agric Res* 39 747 766 1929 *Phytopathology* *27* 1110 1113 1937

Brown N & Gardner F *Ibid* *26* 708 713 1936

Chen H *Nature* *142* 753 754 1938

Chen H Nicol H & Thornton H *Proc Roy Soc* *126 B* 475 491 1940

DeRopp R S *Phytopathology* *37* 201 206 1947

Georgi C & Beguin A *Nature* *143* 25 1939

Grieve B *Proc Roy Soc Vict* n s *53* 323 341 1940

Haagen Smit A Leech W & Bergen W *Science* *93* 624 625 1941

Henry B Riker A & Duggar B *Phytopathology* (Abst) 32 8 1942

Hiltner L *Arb K Gsndhtsamt Abst* *1* 177 222 1900

Kraus E Brown N & Hamner K *Bot Gaz* *98* 370 420 1936

Leonian L *Phytopathology* *21* 117 118 1937

Link G *Nature* *140* 507 1937

Link & Eggers V *Bot Gaz* *103* 87 104

Link Wilcox H & Link A *Ibid* *98* 816 867 1937

Locke S Riker A & Duggar B *Phytopathology* *27* 134 1937 *J Agric Res* *57* 21 39 1938 *Ibid* *59* 519 525 1939a; *Ibid* *59* 535 539 1939b

Mollard M *Compt Rend Acad Sci* (Paris) *155* 131 1534 1912

Riker A Proc Int Cong Microbiol 1939 547 548 1940

Schneider C *Amer J Bot* *25* 258 260 1938

Smith E Brown N & McCulloch L U S Dept Agric Bur Pl Indust Bull No 255 1912

Smith E Brown N & Townsend C U S Dept Agric Bur Pl Indust Bull No 213 1911

Thimann K *Proc Nat Acad Sc* *22* 511 514 1936 *Trans Int Soc* S I S I A 3rd Communication 24 28 1939

Thornton H *Proc Roy Soc B* (Lond) *119* 474 492 1936

Thornton H & Rudorf J *Ibid* *120* 240 252 1936

Virtanen A I & Linkola H *Nature* *158* 515 1946

White P R & Braun A C *Cancer Res* *2* 597 617 1942

Notes and News

UNIVERSITY OF CALCUTTA

Sri Charu Chandra Biswas a former Puisne Judge of the Calcutta High Court has succeeded Prof P N Banerji as Vice Chancellor of the Calcutta University

Son of the late Ashutosh Biswas, Public Prosecutor Alipore (24 Pargannas), Sri Biswas has had a very distinguished record of public services and is connected with his *alma mater* for more than three decades

Sri Biswas has the unique record of standing first in first class in B A (Honours in English and Philosophy), M A, B L, and all other examinations of the Calcutta University and won scholarships medals and prizes

Enrolled as a Vakil of the Calcutta High Court in 1910 he later became an Advocate in 1924 After serving at the bar for more than quarter of a century he was elevated to the bench in 1937 from which post he retired early this year

During this period Sri Biswas had the distinction of being connected with a very large number of social educational and cultural institutions of the city He has been an ordinary fellow of the Senate of the Calcutta University since 1917 a member of the Syndicate since 1928 dean of the Faculty of Law since 1938 and he served on various other academic bodies and committees of the University for more than three decades From 1913 21 he was a professor in the University Law College

Sri Biswas has also been closely associated with the Calcutta Corporation of which he was a commissioner from 1921, and later a councilor since 1925, which office he relinquished in 1937 when he was elevated to the bench. His services were requisitioned by the Government of West Bengal in 1948 as chairman of the Calcutta Corporation Investigation Commission which has just submitted an interim report. From 1928-37 Sri Biswas also served on the Calcutta Improvement Trust of which he was an elected member from the Corporation.

In 1930 Sri Biswas came to the forefront of the public life of this country when he was elected a member of the Indian Legislative Assembly from the Calcutta Urban Non-Mahomedan constituency.

In connection with the proposals for Indian Constitutional Reforms in June 1933 Sri Biswas was invited by His Majesty's Government to participate in the discussions on the Reserve Bank of India and the constitution of a Railway Board for India. In 1936 he was appointed a substitute delegate from India to the General Assembly of the League of Nations at Geneva. Earlier in 1931 he was made a C I E.

Sri Biswas is now the president of the General Council and State Faculty of *Ayurvedic* Medicine and rector of the National Council of Education in West Bengal, Vice-president of the Indian Association for the Cultivation of Science, Calcutta Blind School, the Mahabodhi Society and a member of the Governing Body of the Presidency College, Ripon College, Ashutosh College, Bangabasi College, University Law College, Subhas Institute of Culture (College), South Suburban School, Sir Ramesh Mitter Girls School, Calcutta etc.

A moderate in his political ideas Sri Biswas was a prominent member of the Indian Association and the National Liberal Federation. In every sphere of his activities he was noted for his justice, integrity and honesty of purpose and his talents earned due recognition when he was elevated to the bench. As a judge he will be ever remembered for his masterly judgment on the Bhowal *Sannyasi* case which has become a classic in the legal world.

Sri Biswas was called upon in 1947 to serve on the Radcliffe Committee and to report on the boundary lines between West and East Bengal as a result of the birth of the Dominions of India and Pakistan.

He is appointed Vice-chancellor at a time when the University is faced with major changes in its administrative and academic departments and we have every reason to believe that the work has fallen on a trusted leader. We wish Sri Biswas a period of long and distinguished services for his *alma mater*.

INDIAN SCIENCE NEWS ASSOCIATION

The fourteenth annual meeting of the Indian Science News Association was held on Saturday September 17, 1949 at the Applied Chemistry Lecture Theatre of the University College of Science, Calcutta. Dr D M Bose one of the Vice-Presidents of the Association presided.

Speaking on the occasion Dr Meghnad Saha asked the scientists to take part in solving the country's current problems. It would not do, he said, for scientists who were interested in the country's future to retire to their laboratories. They must work in laboratories but at the same time devote their attention to the burning question of the day.

Independent India, he said, required a new type of education. The number of universities in the country was growing but the quality had not improved. They required more scientists, technicians, engineers and medical men. Above all better organization for research was needed.

Continuing Dr Saha said that the SCIENCE AND CULTURE had conducted a most comprehensive propaganda during the last 15 years of its existence in order that the Government took up the question of proper organisation of the natural resources of the country. This must be done if they wanted to raise the standard of living as well as for the purpose of the country's defence.

Dr Saha said that the most important recommendation which they had made with regard to planning on scientific lines had not been accepted by the Government nor had they set up the national planning commission. Government, he said, instead of proceeding on right lines are muddling in almost all the undertakings which they have taken up. It is true that we have achieved independence after many years and some mistakes at the initial stage are natural. But I hope that they will realise their mistakes in not setting up the planning commission.

Presenting the Annual Report Prof P Ray (Honorary Secretary) referred to the activities of the Association and its financial position. The Association was in receipt of grants and donations during the year under review from Messrs Adair Dutt & Co Ltd, Burmah Oil Co (India Concessions) Ltd, Calcutta Chemical Co Ltd, Indian Association for the Cultivation of Science, Calcutta University, Government of India and Bengal Chemical & Pharmaceutical Works Ltd.

The following were duly elected office bearers and members of the council for 1949-50:—*President*—Prof M N Saha. *Vice Presidents*—Dr S C Law, Dr J C Ghosh, Dr D S Kothari, Dr W D West, Dr S S Bhatnagar, Dr B Prasad. *Treasurer*—Prof P C Mitter. *Secretaries*—Prof P Ray, Prof S K Mitra. *Members*—Prof S P Agharkar, Dr R Ahmed, Sri H P Bhaumik, Dr S R Sen Gupta, Dr K Biswas, Dr P K Bose, Prof K P Chattopadhyay, Dr M S Krishnan, Dr B C Guha, Sri T Sen, Sri B N Maitra, Dr S C Mitra, Prof H K Mookerjee, Dr J N Mukerjee, Dr S R Bose, Dr S L Hora, Dr S Dutta and Dr S K Banerjee.

CONSERVATION OF MINERAL RESOURCES

Formulation of a mineral policy by the Government of India and adoption of measures to implement it as far as possible were advocated by Dr M S Krishnan, Officiating Director of the Geological Survey of

India, presiding at the twenty fifth annual general meeting of the Geological, Mining and Metallurgical Society of India at the Great Eastern Hotel Calcutta on September 16 last

Referring to the question of the conservation and utilization of natural resources of the world and as discussed at a conference by the U N Secretariat at Lake Success recently Dr Krishnan said the conference had focussed attention to the great need for using such resources carefully Because of the two world wars and increasing industrial production these resources including animal and plant products soil water power and minerals were being used at an ever increasing rate The rate of consumption of minerals and metals had vastly increased in recent years in America and Western Europe It was estimated that during the 35 years since 1914 the world had used as much mineral products as in all the previous centuries put together As a result of this rapid consumption the average grade of certain minerals in North America and Europe had gone down though technological advances had enabled them to utilize the lower grades

Referring to conservation of India s mineral resources Dr Krishnan said that India was until now a large exporter of her own mineral raw materials to other countries A vast amount of foreign capital had been invested in the mineral industries of India It was time that India had a mineral policy of her own The main aim of such a policy should be the conservation of mineral wealth which would involve improvement of mining avoidance of waste and the undertaking of research

Conservation of metals and minerals was only possible if they could adopt the latest technique of mining developed by research Their objective should be to effect the maximum recovery from natural materials after the processing with the minimum waste and in the most rational manner

He hoped that all agencies engaged in the mineral industries of the country Government and private would direct their attention to the necessity of conservation of their resources not only by following the latest methods developed by other countries but also by undertaking research schemes themselves

Reviewing the activities of the Society Sri N N Chatterjee Secretary said that with the achievement of independence India had entered a new era It was therefore natural to expect that a national mineral policy would be introduced for the proper development of her mineral resources The sooner such a policy was widely enforced the better for the country s progress in industrialization

The following were elected to form the Council of the Society for 1949 50 Dr M S Krishnan *President* Sri D B Sahana and Sri M L Shome *Vice Presidents* Prof N N Chatterjee and Prof N L Sharma *Joint Secretaries* Prof P C Dutt, *Treasurer* and Prof S Ray, *Librarian*, Sri S K Barooah, Prof D K Chakravarty Dr M Chatterjee Dr A K Dey Sri Gopal Iyer Dr A G Jhingran Dr C S Pichamuthu and Sri M K Ray *Members*

POTATO RESEARCH

The Central Potato Research Institute set up a few months back by the Ministry of Agriculture Government of India recently started functioning at Patna

The Institute which is believed to be the first of its kind in the East will co ordinate research so far undertaken in various sub stations of the Indian Council of Agricultural Research at Simla Bhowali and Kufri and will chalk out a scheme for fundamental research on the production and utilization of the potato crop

For the present the Institute has started functioning in borrowed premises from the Government of Bihar who have placed a 25 acre plot and a few rooms for laboratory and office purposes at its disposal Permanent buildings are not proposed to be built now in view of the need for economy in Government expenditure When the financial situation eases construction of permanent buildings will be taken up

Potato as a nutritive food is a most important item of diet Apart from its energy value it contains appreciable quantities of protein minerals and vitamins B and C In India although the soil is suitable in most areas for potato cultivation only about 0 2 per cent of the total crop area is under potato and the annual production is about 1 800 000 tons Leaving aside the quantity required for seed purposes about 8 lbs of potato are available annually per head as against about 500 lbs per head per annum in some of the Western countries

The main obstacles in the way of increased production of potato in India are (1) absence of different varieties of potato suited to varying conditions of climate and soil in different parts of the country (2) non availability of sound healthy seed in adequate quantities at the right time and at a reasonable price and (3) the heavy toll taken by fungal bacterial and virus diseases and insect pests The Institute will undertake research into these problems Dr S Ramanujam Second Economic Botanist Indian Agricultural Research Institute is appointed Director of the Central Potato Research Institute

ERADICATION OF WHEAT RUST

Co ordinated research on wheat rust on an all India basis will now be undertaken as a result of a comprehensive scheme recently sanctioned by the Central Ministry of Agriculture A sum of Rs 8 58 800 has been sanctioned for the purpose for the first five years beginning from April this year The scheme which is now proposed to be launched aims at evolving a type of wheat which is simultaneously resistant to all the various kinds of rust keeping in view the botanical mycological and agronomical aspects of the problem

It may be recalled that in 1947 a committee on wheat rust control was appointed by Dr Rajendra Prasad the then Minister for Food to go into the problem and suggest measures for the final elimination of rust The committee recommended both short term and long term measures

Among the steps recommended to be undertaken under the short term scheme was to give a trial to the theory that while infection is killed in the plains by the intense summer heat it is carried from season to season by the summer sowings of wheat and barley *mainly in the Nilgiris and Palni Hills* On this basis it is held that if sowings of wheat and barley in summer are completely stopped in Peninsular India the source of infection will disappear and the menace of rust will be mitigated if not completely eradicated This theory is being given a trial in consultation with Provincial and State Governments concerned

The second short term scheme recommended by the Committee was the seed mixture trial which aims at a mixture of those varieties of wheat seeds which are claimed to be tolerably resistant to the three kinds of rust individually This scheme is now a part of the Grow More Food campaign

The long term scheme recommended by the Committee which has now been sanctioned deals with the mycological botanical and agronomical aspects of the problem and research would be conducted on the following lines (a) Finding out the physiological races of the three kinds of rust and maintaining their live culture (b) breeding of wheat varieties resistant to all the three types of rust and (c) ascertaining whether the effect of rust can be minimised by changing cultural and manurial practices for example changing the time of sowing the method of manuring cropping spacing and so forth

The general programme of work relating to the scheme will be laid down by the Wheat Rust Control Committee and the necessary co ordination will be done by the Indian Council of Agricultural Research The actual scientific work and the collection of data will be carried out by the Indian Agricultural Research Institute

AGRICULTURAL RESEARCH ON A REGIONAL BASIS

Research problems on agriculture and animal husbandry will now be considered under three main categories namely fundamental regional and local with a view to ensuring that adequate attention is paid to each problem according to its importance This new procedure has been laid down by the Indian Council of Agricultural Research in pursuance of a decision taken at the last meeting of the Governing Body of the Council to undertake research on a regional basis

The Regionalisation Committee of the Council, whose report was recently adopted by the Governing Body as an experimental measure for a period of two to three years for the present suggested that in future all agricultural and animal husbandry research work should be classified as fundamental regional and local Fundamental problems will be allotted, as far as possible to the Central Institutes of Research Universities and other research bodies like Central Commodity Research Stations The regional problems will be financed on a contributory basis by the Indian Council of Agricultural Research and the Provinces best suited to take them up while local problems will be assigned to respective Provincial Governments

The Committee divided the country into five main regions for agricultural research purposes namely (1) Dry Northern Wheat Region (2) Eastern Rice Region, (3) Southern Millet Region (4) Temperate Himalayan Region and (5) Coastal Region On the animal husbandry side the first four Regions were adopted and the coastal region was for the time being proposed to be included in the Eastern Region Formation of regional committees was also recommended

The Regional Committees on Agriculture have already been set up with the Agricultural Commissioner of the Government of India as the *Chairman* and Directors of Agriculture of the Provinces constituting a particular region as *member* These Committees met during the last summer at various Regional Centres the Wheat Committee at New Delhi the Rice Committee at Calcutta the Millet Committee at Nagpur the Himalayan Regional Committee at Simla and the Coastal Regional Committee at Mysore The experience gained from discussions at the Regional Committee meetings have proved the effectiveness of the new procedure and the Council have now addressed all Provincial Governments that research schemes should be drawn up according to the new procedure

INDIA CAN BENEFIT FROM THE U S A PATENT OFFICE

America's greatness stems to a great degree from the impetus given to individual ambitions by provisions of the Federal Constitution Among constitutional provisions which enhance the individual's worth to himself and to society is the one giving the U S legislature the power to grant him the exclusive enjoyment of his inventions and discoveries for a limited period This is the fountain head of authority for the U S patent system Thanks to this patent system creativeness can be freely expressed with good of his country as a whole

By now the patent office has issued a total of two and a half million patents concerning every conceivable human activity in every part of the world These patents constitute the greatest body of technical literature ever amassed Without the various aspects of this patent system America could not have reached anything approaching her present industrial and economic power

The U S A patent system is open to the people of India as it is to anyone in the world except persons who are classed by the U S A as enemy aliens Its protection is given to Indians to exactly the same extent for exactly the same cost as it is to American citizens The fees charged by the U S A government are $30 (about Rs 150) upon filing the application and another $ 30 upon completion of examination and acceptance If application is rejected an appeal can be filed for a fee of $15 (Rs 75) The fees expected by the attorney or agent vary considerably The science division of New York s reference library has excellent facilities in this line

Once the patent issues there are no additional fees for its maintenance and no provisions for compulsory working or for compulsory licencing under the patent Even if the patentee does not work the patented invention himself he may prevent others from infringing it There are no renewal fees taxes or assessments whatsoever through the 17 years of the patent s existence The total amount paid in ordinary cases is thus $ 60 (Rs 300) for 17 year protection In India s patent system the applicant first pays the Indian government an application fee of Rs 30 and a sealing fee of Rs 30 After the first four years of the life of the patent (which are free) the patentee must pay renewal fees of Rs 50 for the second four year term Rs 100 for the third and Rs 150 for the final 4 year term This totals Rs 1260 for protecting an invention in India for 16 years as compared to Rs 300 for 17 years of protection in the U S A

The number of patents granted per million population in U S A is 374 while it is only 2 in India 86 8 percent of the total of patents taken out in U S A annually are taken out by U S A citizens In India only 10 percent are granted to Indians and 90 percent to foreigners In 1946 of the 2 608 applications filed in the Indian Patent Office 18 percent were filed by U S A nationals

PLANS FOR INTERNATIONAL COMMODITY CLEARING HOUSE

Intermational commodity experts have drawn up a plan for creating a world clearing house for dealing with food surpluses It would be designed to avert the difficulties arising from the accumulation of unsold agricultural products The scheme has been prepared at the request of the Food and Agricultural Organisation and will be considered at the annual conference in November

Recommendations contained in the experts' report have been endorsed by the Director General of the F A O , Mr Norris Dodd The main proposal it contains is for the creation of a new world organisation to be known as the International Commodity Clearing House This body would be responsible for assisting the smooth clearance of products in agricultural markets in order to forestall the danger of surpluses accumulating Should such surpluses occur it would have the authority to acquire them and dispose them off to the best advantage

This organisation would in all its activities work through the Governments who are members of the F A O or through such other channels as they might approve Membership in this Clearing House would be open to all members of the F A O and the United Nations It is suggested that it should be set up as a public corporation with a capital of $ 5 000 millions

The report divides the functions of this new world agency into seven main heads The first and second deal with the buying of surplus stocks and commodities and with negotiations for the sale of these The other functions are concerned with the holding of stocks acquired during periods when there is a glut with exchange commodities on a barter basis and with the arrangement of bilateral or multi lateral trade agreements

The experts indicate that they do not anticipate a surplus occurring in several commodities among which are included coffee and wool But they do envisage that the production of sugar cotton certain fats and oils may exceed demand within the next 12 months During the next three years they consider that there is an almost certain prospect of surpluses occurring

BIBLIOGRAPHY OF SCIENTIFIC PAPERS

One of the functions of the Field Science Co operation Office of UNESCO in South Asia is to facilitate exchange of scientific information both within the region and with the outside world During the 16 months of its existence the office handled more than 200 requests A large number of these requests are for information on scientific literature and publications Because of the limited circulation these publications are not readily available to scientists in other parts of the world Not infrequently even the existence of a paper is unknown and in this way some notable contributions to scientific knowledge may be obscured A rough estimate shows about 10,000 scientific papers appear in this region every year So far no comprehensive bibliography or documentation has been made of them In order to fill this need the Field office proposes to compile a regional scientific bibliography to be distributed among the institutions and the outside scientific world through the other Field Science Offices of UNESCO the International Scientific Unions and the leading abstracting services It is hoped that such a bibliography will serve to increase the exchange of scientific literature and will enable the world to derive more benefit from contributions of this region

To start with it is proposed

(i) that the bibliography is to be published annually with supplements whenever necessary

(ii) that only the titles authors and references of the scientific publications will be given and no abstract will be attempted at present

(iii) that all branches of pure and applied sciences (Medicine Agriculture Engineering) as well as social historical and educational aspects of science will be included

(iv) that only scientific publications published in the South Asia region (Afghanistan Pakistan India Ceylon Burma Thailand Malaya Indonesia etc) will be included

(v) that emphasis will be given to reports of original experimental work Books monographs reviews surveys annual reports etc will be included whenever possible

Cooperation is solicited of all scientific organizations and individual scientists of this region to make the bibliography as complete as possible Scientists are cordially invited to send their reprints reports or other publications which are not readily available to enable the Science Co operation Office for South Asia at Delhi University to make the project a success

SOME ASPECTS OF PARSI DEMOGRAPHY

The growth of the Parsi Community its demographic trends and their implications for the future are described in this paper by Sri C Chandrasekar The Parsis, who were originally the inhabitants of Iran left their country to avoid religious persecution under the Mohammedan rulers and came to India as refugees in the 7th century A D Despite their long stay in India the Parsis have preserved their ethnic identity by means of rigid social and religious norms The Parsi population in India (excluding Burma and Aden) grew from 85 314 in 1881 to 114 890 in 1941 This increase of 35% is decidely lower than that of 56% for India s total population and that of England s 54 % for the same period as a fair proportion of the Parsi increase was due to fresh immigration of Iranian Zoroastrians into India The Parsi birth rate has been declining rapidly in the past few decades In Bombay, where 50% of the Parsis live the birth rate was as high as 25 per 1000 in the period 1901 20 In the decennium 1921 30 the birth rate started to diminish and in 1930 it was 20 per 1000 Prior to the outbreak of the Second World War the rate was only 17 per 1000 The decline in the Parsi birth rate seems to have been deliberately brought about The age at marriage of the Parsis has increased and the fertility of married women diminished In Bombay the number of births per 1000 married women was 190 in 1901, 218 in 1911 160 in 1921 and 139 in 1931 The growing demands made on the Parsi relief organizations for family assistance indicate that the Parsis of today are finding their means insufficient to satisfy their needs Economic motive appear responsible for the restriction of the size of the families The health of the Parsis has improved markedly in the last few decades, whereas in the beginning of the century the death rate was 30 per 1000, by 1930 it had decreased to 15 per 1000 The infant mortality rate also diminished from over 150 to 1000 live births prior to 1925 to 68 per 1000 live births in 1944 The improved health conditions are well reflected by a marked increase in the expectation of life In 1910 12 the expectation of life at birth was 37 6 years for male and 38 4 years for females In 1930 32 the expectation of life for males was 52 2 years and for females 54 2 years The Parsi fertility rate is now so low that at this level and the mortality conditions now prevailing 1000 women of the present generation will in due course be replaced by only 830 If the present conditions continue indefinitely the population will increase temporarily to 115 337 by 1951 Sometime between 1951 and 1961 the population will start diminishing in numbers and by the year 2001 the population size will be only 89 218 The possibility of a decline in the number is commended to the attention of the Parsis so that they may devise such social and population policies by which the rich heritage of their community could be preserved for the betterment of mankind (*Human Biology* 20 Pp 47 89 1948)

POLONIUM RADIATION RISKS

The report recently issued by Dr Bryan and Silverman of California University s medical school atomic research group points out that serious radiation hazards may develop in the area around the devices which have been produced to eliminate static charges through the employment of thin strips of the element polonium Polonium used commercially is effective in eliminating static electricity produced by belts and pulleys paper passing over metal rolls and other machinery It emits alpha particles to form a conductive layer of ionized air between the dielectric material and a portion of the machine which is grounded A survey of industrial plants in the Los Angeles area has revealed dangerous radioactivity in the area in which eliminator devices were stored

Dr Bryan stated that the radiation of polonium doses not penetrate the skin but an internal hazard may develop from radioactive particles absorbed by inhalation or hand to mouth contact It is also suggested that such static eliminators should be used only when suitable monitoring instruments are available and workers are properly trained to handle radioactive material (*The Chemical Age* August 20 1949)

AUSTRALIAN FELLOWSHIPS FOR INDIAN STUDENTS

The Government of the Commonwealth of Australia have offered five Fellowships and one Scholarship for the year 1950 to Indian students for studies in Australia These awards are open to both men and women Candidates should send in their applications to the Ministry of Education (Section A 1), through the Heads of the respective institutions in which they are studying or are employed Full particulars may be had from the University or the Director of Public Instruction concerned

The senior Fellowships are intended to provide higher training facilities and general experience in Australia to suitable persons who may or may not be University Graduates and who are already engaged in responsible work connected with national development The selected candidates will be given appropriate training for a period of 12 months The junior Fellowships are intended to provide opportunities for post graduate study at Australian institutions for students who have recently completed courses of academic professional technical or general training but whose eventual contribution to national development may be increased by a period of further training Students who are awarded junior Fellowships may in certain circumstances work for a formal degree The period of training under the junior Fellowships will be six months to two years The Scholarship is expected to provide opportunity to a student to undertake a course up to four years in duration at an institution providing professional academic technical or rural training in Australia leading to a degree

ANNOUNCEMENTS

We extend a hearty welcome to Sri S N Sen Registrar Indian Association for the Cultivation of Science Calcutta who has been nominated by the Indian Science News Association to serve on the Editorial Board of SCIENCE AND CULTURE *vice* Prof M N Saha resigned Well known to our readers through his writings Sri Sen has been intimately associated with the life of this journal as an Associate Editor since 1941 excepting the years 1947 49 when he served at the UNESCO Secretariat at Paris

The Editorial Board of SCIENCE AND CULTURE for the year 1949 50 will be constituted as follows

Dr D M Bose Prof S K Mitra (*Ex officio*) Prof P Rây (*Ex officio*) Dr A C Ukil and Sri S N Sen

Dr B C Guha who recently attended the 1st International Congress of Biochemistry held at Cambridge and who presided over the session on Vitamin has been elected to the International Committee for Biochemistry by the Congress

Dr Guha is also the only Indian representative on the Provisional Committee of the Indian National Union of Nutrition Sciences

Dr D D Kosambi of the Tata Institute of Fundamental Research of Bombay has been given a UNESCO fellowship to work on the new types of electronic calculating machines for setting up a modern calculating laboratory in Asia

Kosambi has been invited as a visiting professor by Chicago University He will also visit the Institute for Advanced Study at Princeton and serve on a committee of mathematicians to select the recipients of Field Medals which will be awarded at the forthcoming International Congress of Mathematicians (Massachusetts)

Dr V S Waravdekar Assistant Research Officer of the Indian Research Fund Association Government of India who has been awarded a Research Fellowship by the Federal Security Agency of the U S Public Health Service is doing research in cancer at the National Cancer Institute Bethesda Maryland His special field of study is the activity of enzymes in animal tumors screened with different compounds

LETTERS TO THE EDITOR

[*The Editors are not responsible for the views expressed in the letters*]

TEMPERATURE DEPENDENCE OF U H F RADIO WAVES IN SOME ORGANIC LIQUIDS

Following up the work of Drude[1] Romanoff[2] and others Mizushima[3] studied the anomalous absorption of radio waves by some alcohols acetone and ether using first wave lengths ranging from 3 metres upto 50 metres He observed discontinuities in the temperature dielectric constant curves for certain wavelengths in the case of alcohols and deduced from these discontinuities an absorption peak in case of glycerine at −69°C for wavelength 6 3 metres Acetone and ether did not show any absorption in this region even at the low temperature mentioned above In his later work[4] Mizushima used shorter wavelengths of the order of 58 cms and repeated the investigations in the case of alcohols and glycerine He deduced an absorption peak in the case of glycerine at 30°C for λ equal to 57 8 cms The absorption in acetone was not studied by him for these short wavelengths

The results for glycerine reported by Mizushima clearly show that the frequency of the absorption peak deduced from the values of dielectric constants diminishes at lower temperatures This fact was explained by Mizushima on Debye s theory assuming that viscous forces increase at lower temperatures He also suggested that as observed in case of water vapour these absorption maxima in alcohols and glycerine might be due to rotational transitions of molecules in the liquid In Debye s theory however only rotation with constant angular velocity is assumed and no rotational transition of the molecule is postulated Hence in order to understand this phenomenon more clearly direct absorption of U H F radio waves having wavelengths ranging from 57 cms to 3 metres generated by a General Radio Type 857 A U H F oscillator has been studied in case of a few organic liquids at different temperatures by the present authors A tuned crystal detector provided with a microammeter in series was used to measure the absorption and the glass cell containing the pure liquid was placed between the vertical aerial connected to the oscillator output and the detector Log I_0/I is plotted against different frequencies for each temperature of the liquid I_0 and I being respectively the currents in the tuned detector without and with the absorbing liquid in its position The results for acetone obtained in the preliminary investigations are given in Fig I

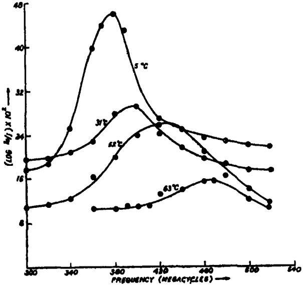


Fig 1

Absorption in acetone

It can be seen from Fig I that U H F radio waves are absorbed directly by acetone in the range studied and there are two characteristics of the absorption phenomenon *e g* (1) that the position of the absorption peak shifts towards higher frequencies with increase of temperature and (2) that the height of the peak diminishes with the rise of temperature of the liquid The first characteristic feature was noticed by Mizushima in the results deduced from dielectric constant measurements but the second feature has been missed by him These two characteristics of the absorption band clearly show that the absorption is not due to any rotational transition of the molecule in the liquid The absorption seems to be caused by the fact that the polar molecules in the liquid execute angular oscillations in the field of surrounding molecules and as this latter field lacks in spherical symmetry the permanent moment of the oscillating molecule changes during the oscillation Thus as the molecule oscillates with its natural frequency the permanent moment of the molecule also oscillates with the same frequency and hence a radiation of electro magnetic waves of that frequency takes place Such oscillations of the molecule may be caused by thermal disturbances or they may be induced by incident electromagnetic waves of suitable frequencies and in the latter case absorption takes place Since the natural frequency of the molecules will be dependent on viscous forces the frequency is expected to diminish at lower temperatures Also the influence of the surrounding molecules on the permanent moment of the molecule diminishes with the rise of temperature owing to increased randomness of the distribution of the molecules The amplitude of the oscillating part of the permanent moment is therefore expected to diminish with the rise of temperature The observed features of the phenomena are thus explained by the new hypothesis

The investigations are being continued with different organic liquids and the results will be reported elsewhere

S C SIRKAR
S N SEN

Indian Association for the
Cultivation of Science
210 Bowbazar Street
Calcutta 4 8 1949

Drude P Wied Ann 8 1 1896
Romanoff W Ann der Phys 69 1 5 1[illegible]
[3] Mizushima S Sc Pap Inst Phys & Chem Research (Tokyo) 201 19 7
Mizushima S Sc Pap Inst Phys & Chem Research (Tokyo) 09 19 8

NOTE ON TWO EXOTIC PLANTS FROM SOUTH INDIA

There are a large number of exotic plants in South India and these have been mentioned in various books Recently the writer came across two attractive ornamental plants which seem to have escaped the attention they deserve Neither of them are recorded in the catalogues (1848 98) of the Agri Horticultural Society of Madras or in the Gamble s Flora of Madras One of them (*Phytolacca dioica* Linn) is however mentioned by Fyson[1] The plants are as follows

(i) **HAKEA SERICEA** *Schrad* (*Proteaceae*) syn *Hakea acicularis* (Vent) Knight

This plant has the general appearance of a conifer with numerous needle-like leaves but it has also showy flowers and nut-like fruits The plant is a native of Australia and appears to have been introduced in the Nilgiris in recent years, It is represented by one sheet collected from the Nilgiris by *R S Vine* (no. 266 in *Herb Kew*)

(ii) PHYTOLACCA DIOICA *Linn* (*Phytolaccaceae*)

This is a small tree which is probably an evergreen It bears numerous small white flowers on drooping racemes The plant is a native of Tropical South America but has been introduced in the Mediterranean region, Egypt, India and Australia The earliest available records of its introduction in India appears to be about the year 1850 when Griffith collected the plant from the vicinity of Serampore (West Bengal) Even earlier collections (Wallich, 6958) have been wrongly identified as *Phytolacca dioica* Linn by Walter[2] There is of course no doubt that Wallich's sheets no 6958 from Nepal are *Phytolacca acinosa* Roxb

Subsequently this plant (*Phytolacca dioica* Linn) was collected around Bombay by Dalzell and there are also collections from the Calcutta Botanic Garden In 1908 Bourne, collected this plant from the vicinity of Ootacamund which appears to be the place where this plant has naturalised in South India (*Vide* Fyson[1]) It will be of interest to find out if this plant is still thriving around Calcutta or Bombay, but there is evidence that the plant is well established in the Nilgiris as we have received in Kew, flowering twigs of this plant for determination from South India as recently as March 1947

D CHATTERJEE

The Herbarium,
Royal Botanic Garden
Kew, 26 2 1949

---

[1] Fl South Ind Hill Stations 480 *et tab* 427,1932

[2] In Engl Pflanzenreich—*Phytolaccaceae* 49 1909

TWO DIMENSIONAL SYSTEMATIC SAMPLING

The population to be sampled consists of ml rows of nk cells in mn strata, each of size lk y=const gives a row and x=constant gives a column In each row there are n sets of k cells and in each column m sets of l cells In the stratum (0, 0), ν cells out of lk cells are chosen at random Then every lth row of cells beginning from the one in which each of these chosen cells occurs, is selected On each of these rows Oth and every kth cell is taken, thus comprising a sample of size $mn\nu$, which is a kind of systematic sampling in two dimensions We may also take a random sample of size ν from each of the mn strata forming a total stratified sample of size $mn\nu$ Alternatively, $mn\nu$ cells may be taken at random out of $mnlk$ cells which will constitute a perfectly random sample without stratification

As in Cochran[1] we shall consider this finite population to be a sample from an infinite population in which $E(Z_{ij}) = \mu$, $V(Z_{ij}) = \sigma^2$ and Cov $(Z_{ij}, Z_{i+u, j+v})$ $\sigma^2\rho(u, v)$, where Z_{ij} is the observable in the cell (i, j), and $\rho(u, v)$ is the usual space correlation Here the variances of the grand sample mean under random, stratified and systematic sampling as averaged over all finite population from the infinite population will be denoted by σ_r^2, σ_{st}^2 and σ_{sy}^2 respectively We shall put $\rho\ (u, v) + \rho(-u\ \ v) - \psi(u, v)$

Then it can be proved that

$$\sigma_r^2 = \frac{\sigma^2}{mn\nu}\left(1-\frac{\nu}{lk}\right)\left[1-\frac{\phi(ml\ \ nk)}{(ml\ \ nk=1)}\right]$$

$$\sigma_{st}^2 = \frac{\sigma^2}{mn\nu}\left(1-\frac{\nu}{lk}\right)\left[1-\frac{\phi(l,k)}{(l\,k-1)}\right]$$

$$\sigma_{sy}^2 = \frac{\sigma^2}{mn\nu}\left(1-\frac{\nu}{lk}\right)\left[1-\frac{\phi(ml,\ nk)}{(l\,k-1)}\right.$$

$$+\frac{2\,lk}{(lk-1)}\left\{\sum_{v=1}^{m}\frac{(m-v)}{m}\rho(o,vl)+\sum_{u=1}^{n}\frac{(n-u)}{n}\rho(u\,k,\ o)\right.$$

$$\left.\left.+\sum_{u=1}^{n}\sum_{v=1}^{m}\frac{(n-u)(m-v)}{mn}\ \psi\ (u\,k,\ v\,l)\right\}\right]$$

where, $\tfrac{1}{2}\phi\ (M,N) = \sum_{v=1}^{M}\frac{(M-v)}{M}\rho(o,\ v) + \sum_{u=1}^{N}\frac{(N-u)}{N}\ \rho(u\ \ o)$

$$+\sum_{u=1}^{N}\sum_{v=1}^{M}\frac{(M-v)(N-u)}{MN}\ \psi(n,\ v)$$

Thus the relative efficiencies $1/\sigma_r^2$ $1/\sigma_s^2$ $1/\sigma_{sy}^2$ are independent of ν Then the following theorems have been proved giving sufficient conditions

Theorem 1 For all infinite populations in which (i) $\Delta_1\psi(u, v) \leqslant 0$, (ii) $\Delta_2\psi\ (u, v) \leqslant 0$, (iii) $2\psi(u, v+1) \geqslant \psi(u+1,\ v+1)+\psi(u+1,\ v)$ and (iv) $2\,\psi(u+1,\ v) \geqslant \psi(u+1,\ v+1)+\psi(u\ \ v+1)$ $\sigma_{st}^2 \leqslant \sigma_r^2$ for any size of the sample,

Where Δ_1, Δ_2 are the usual notations for finite differences with respect to u and v respectively

Corollary This will be true also if only conditions (i), (ii) hold, together with $\Delta_1\psi = \Delta_2\psi$

Theorem 2 For all infinite populations in which stratification is made by parallel stripes along u—directions (say), $\sigma_r^2 \geqslant \sigma_{st}^2$ for any size of sample, if (i) $\Delta_1\psi \leqslant 0$, (ii) $\Delta_2\psi \leqslant 0$, and (iii) $2\,\psi(u+1,\ v) \geqslant \psi(u,\ v+1)+\psi(u+1,\ v+1)$ Condition (iii) may also be replaced by $\Delta_1\psi \geqslant \Delta_2\psi$ which is a more stringent condition.

Theorem 3 For all infinite populations in which (i) $\delta_1^2 \rho(u\ v) \geqslant 0$ (ii) $\delta_2^2 \rho(u\ v) \geqslant 0$ and (iii) $\delta_1^2\ \delta_2^2\ \rho(u\ v) \geqslant 0$ $\sigma_{sy}^2 \leqslant \sigma_{s}^2$ for any size of the sample and $\sigma_{sy}^2 = \sigma_{st}^2$ if equality holds in each of the above three cases

where δ_1 δ_2 are central difference notations with respect to u and v respectively

A C DAS

Dept of Statistics
Calcutta University
25 7 1949

Cochran, W G Relative accuracy of systematic and stratified random samples for a certain class of populations *Ann. Math. Stat* *17* pp 164 177 1946

SEX IN *CASUARINA EQUISETIFOLIA* FORST

The genus *Casuarina* is monotypic of the family *Casuarinaceae* Four species under the genus *viz* *C equisetifolia* *C quadrivalvis* Lab *C glauca* Sieb *C suberosa* O & Dietr are introduced into this country Of these *C equisetifolia* is widely cultivated especially along sea shore sands for its fuel value while the other species are found as stray plants in Nilgiris and Kodaikanals in Madras Presidency

Though the genus *Casuarina* has species which are monoecious or dioecious *C equisetifolia* Forst has been described differently as monoecious by some authors and as dioecious by others

Bentham[2] and Bailey[1] have recorded this Australian species as dioecious Similarly Roxburgh[10] mentions that the female flowers are borne on a different tree Hooker[9] describes the flowers as dioecious with a query Drury[4] treats *C muricata* Roxb a synonym of *C equisetifolia* Forst under monoecia monandria in his Indian Flora (1869) but in the second edition of the useful Indian plants[5] in 1873 the same author mentions that the female flowers are borne on a different tree thus meaning it to be dioecious Graham[7] in the Catalogue of plants growing in Bombay and its vicinity has treated this species under monoecia monandria but Cooke[3] in his Bombay Flora has described it as dioecious Haines[8] in the Botany of Bihar and Orissa puts it thus — Prain in Bengal plants probably following Roxburgh says dioecious (without the?) but the trees growing in the Calcutta garden are certainly monoecious and I have never seen them otherwise

Thus it is seen that the species *C equisetifolia* is treated by some as monoecious and by others as dioecious (with or without doubt) Gamble[6] described the family as monoecious or dioecious termed the genus *Casuarina* as monotypic but has omitted to refer specifically to the distribution of sex in the species

The authors had opportunities for collecting and examining specimens from various centres in the Madras Presidency and these specimens are now deposited in the Madras Herbarium at Coimbatore They come to the conclusion that *C equisetifolia* Forst behaves both as monoecious and dioecious (Fig 1)

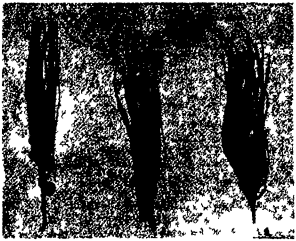


Fig 1

1 and 2 Branches from dioecious types. 1 Female 2 Male
3 Branches from a monoecious type

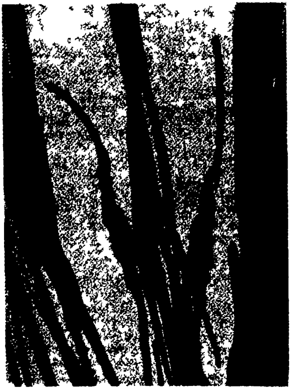


Fig 2

Male spike intercalary in the branchlets

This appears to be similar to the case of *Carica papaya* wherein male, female and monoecious plants have been recorded Very rarely both the types occur freely in the same locality Evidently due to this varied distribution of the monoecious and dioecious types there had been some amount of confusion among the botanists

The male flowers of this species are usually borne on pendulous spikes terminating slender deciduous branchlets In one of the specimens collected the male spike was observed to be occurring at the base or middle of the branchlets and the vegetative shoot continued beyond the flowering shoot (Fig 2) Thus the male spike was intercalary in the branchlets

S N CHANDRASEKHARAN
S V PARTHASARATHY
D DANIEL SUNDARARAJ

Madras Herbarium
Agricultural College and
Research Institute
Coimbatore 30 4 1949

Bailey F M Queensland Flora 1490 1902
[2] Bentham G Flora Australiensis *6* 197 1873
[3] Cooke T Flora of the Presidency of Bombay *2* 660 1908
[4] Drury H The Indian Flora *3* 266 1869
[5] ——The useful Indian plants, 2nd Edition 124 1873
[6] Gamble J S Flora of Madras Presidency 1389 1928
Graham J Catl of Plants grow ng in Bombay and its vicinity 196 1939
[8] Haines H H The Botany of Bihar & Orissa 840 19?4
[9] Hooker J D Flora of British India, *5* 598 1890
[10] Roxburgh W Flora Indica, *3* 52 1832

STUDIES ON THE STERILITY EFFECT OF THE OIL OF *PISUM SATIVUM* LINN

Previous to this work Nag and Pain[1, 2] in connection with their nutrition experiments with Indian food stuffs especially with cereals observed that by feeding sets of different pairs of white rats on *Pisum sativum* the litter production capacity can be checked From their detailed work on the feeding experiments they concluded that *Pisum sativum* is either completely devoid of any Vitamin E or it might contain something to antagonise the effect of sex hormone responsible for litter production

The present note deals with the anti sexhormonic effect of the oil of *Pisum sativum* extracted from the ripened seeds by standard method Unlike all the other known products this oil produces its sterility effect by antagonising or diminishing the activity of the sex hormones

The studies on the physical characters of the oil as regards its Sp gravity, iodine value saponification value, amount of unsaponifiable matter, spectrophotometric analysis and also the chemical structures etc will be discussed in a separate communication

In the beginning the effect of the oil was studied on living white rats in the production of litters Sets of pairs of young white rats, about 60 days old were housed in different cages and fed with normal diet of grain and water One pair was left as control which produced litters in the expected time (95 days) Of the second series the males were injected with 0 1 cc oil of *Pisum sativum* twice a week till 90 days of their life In the third series the females were similarly injected Both the second and third series failed to produce any litter even up to 200 days This shows that the oil of *Pisum sativum* is responsible for this sterility effect It further shows that the oil is also effective on both the sex

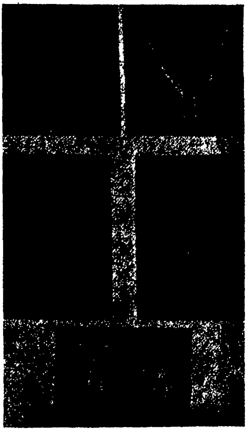


Plate 1

Photographs showing the effect of sex hormore Sterility oil and Vitamin E on the male and female white rats
1 Ovaries and uteri in normal condition before any injection was given (same size)
2 The same after the injection of Pregnyl (same size)
3 The same after the injection of Pregnyl and Sterility oil (same size)
4. The same after the injection of of Pregnyl and Sterility oil and Vitamin E (same size)
5 Testes and ducts after the injection of Antuitrin S (× ½);
6 The same after the injection of Antuitrin S + Sterility oil (× ½)

In this connection further study was made to test how far the oil of *Pisum sativum* can act as inhibitory factor for the change produced by the Estrogens such as Pregnyl (O L) and Antuitrin S (P D) These products are known to bring about maturation of the sex organs of immature (21 to 23 days old) white rats (standard methods) Pairs of young immature white rats about 23 to 30 days old were housed in different cases and fed normally as before First pair was set aside for control Second pair was given the same doses of Pregnyl (30 I U) for five days The third pair was injected with Pregnyl (30 IU) and oil of *P sativum* 0 1c c and the fourth pair was injected with Pregnyl and the oil of *Pisum sativum* and Vitamin E in 10 mg doses for the same period as before Similar experiments were performed also with Antuitrin S After eight days all the animals were autopsied and the sex organs were carefully dissected out and photographed Subsequently the sex organs were dissected out individually and weighed The results are given in tables I and II

TABLE I

Showing the effect of Estrogen Estrogen and Sterility oil and estrogen Sterility oil and Vitamin E on immature female white Rats (23 days old)

	Original Wt	Final Wt (Autopsy)	Increase in Wt (In 8 days)	Wt of two Ovaries	Uterus Wt
Control (No injection)	31 gm	35 gm	4 gm	20 mg	70 mg
Injected Pregnyl 30 IU (For 5 days)	31 gm	40 gm	9 gm	40 mg	230 mg
Injected Pregnyl and Sterility Oil 0 1 cc (For 5 days)	31 gm	39 gm	8 gm	21 mg	170 mg
Injected Pregnyl Sterility Oil and Vit E (For 5 days)	39 gm	49 gm	10 gm	40 mg	260 mg

TABLE II

Showing the effect of Antuitrin S and Antuitrin S and Sterility Oil on Immature Male Rats (30 days old)

	Original Wt	Final Wt	Increase in Wt	Wt of two Testis	Wt of Seminal Vesicles	Wt of Prostate
Injected Antuitrin S 25 RU (For 7 days)	41 gm	49 gm	8 gm	680 mg	150 mg	40 mg
Injected Antuitrin S and Sterility Oil 0 1 cc (For 7 days)	36 gm	40 gm	4 gm	300 mg	40 mg	20 mg

TABLE III

Showing the Effect of Androgen, Androgen and Sterility Oil and Androgen Sterility Oil and Vitamin E on the Castrated Cocks

	LENGTH (Maximum) Initial	LENGTH (Maximum) final	Increase	BREADTH (Maximum) Initial	BREADTH (Maximum) Final	Increase
Control	Comb 42 mm			Comb 16		
(No injection)	Spur 24		—	Spur 15		
Testoviron	Comb 42 mm	62 mm	20 mm	Comb 16 mm	32 mm	16 mm
5 mg (4 injections)	Spur 24 mm	29 mm	5 mm	Spur 14 mm	36 mm	22 mm
Testoviron Sterility Oil 0 2 CC (4 injections)	Comb 42 mm Spur 24 mm	56 mm 24 mm	14 mm 0 mm	Comb 14 mm Spur 15 mm	17 mm 28 mm	3 mm 13 mm
Testoviron Sterility Oil and Vit E 15 mg (4 injections)	Comb 42 mm Spur 25 mm	68 mm 29 mm	26 mm 4 mm	Comb 16 mm Spur 16 mm	32 mm 38 mm	16 mm 22 mm

From the above results it is evident that though the effect of Antuitrin S or Pregnyl (Estradiol & Progesterone) is diminished by the oil of *Pisum sativum* the administration of Vitamin E nullifies the effect of this oil

It is known that the comb and spur of castrated cock normally remain very small but these become well developed when the male sex hormones or androgens such as testosterone propionate is injected to the bird Only two to four injections of 5 mg each is quite sufficient to bring those to normal size In this experiment three castrated cocks of the same size and age were injected—one with Testoviron (Schering) and second with Testoviron and the oil of *Pisum sativum* (0 1 cc) and the third with Testoviron and the oil and Vitamin E (10 mg) In the first case comb and spur increased markedly in the second increase was much less than that of the first and in the third the increase in the comb and spur was as much as that of the first The results are given in table III This will show that the oil of *Pisum sativum* also partially antagonises the effect of the male sex hormones or the androgens while Vitamin E counteracts its effects

Plate 2

Photographs showing the results of the Cocks on experiments performed

1 Normal and untreated castrated cock
2 Injected with Testoviron
3 Injected with Testoviron Sterility oil
4 Injected with Testoviron + Sterility oil + Vitamin E

Further studies in the changes in the vaginal epithelium (Allen and Doisy[3]) spermatozoa test and also the histological changes are in progress Some valuable evidences have been received already from those studies From the above experiments it is evident that the oil of *Pisum sativum* which may be called as sterility oil reduces the effects of both the estrogens and androgens It has been shown that although the sterility oil partially antagonises or reduces the effects of the sex hormones— both estrogens and androgens it cannot completely suppress the effect of them This fact is evidenced by the partial increase in the size and weight of the ovaries and uterus of rats and that of the comb and spur of castrated cocks The normal increase in the weight of the rats also bear a proof that this sterility oil does not affect the general health Hence it can be assumed that in the use of this sterility oil derived from *Pisum sativum* there is no risk of any general systemic disturbances Further the advantage lies in the fact that normal fertility can be resumed sometime after discontinuing the administration of this oil or by vigorous administration of Vitamin E In short the sterility effect is not absolute but temporary Therefore it can be taken that this sterility oil reduces the optimum condition for the litter producing effect of the sex hormones partially for the time being and never adversely affects other systemic conditions As it is found that Vitamin E can bring about the optimum condition for the sex hormones in the production of litters inspite of the use of the sterility oil this sterility oil in the properly extracted and standardized form can be used safely as contraceptive

It is a known fact that too much administration of the sex hormones (estrogens and androgens) may sometime lead to the development of cancer (Cramer)[4] We are trying to determine whether this sterility oil can in any way prevent the development or arrest the growth of carcinoma produced due to the excessive use of sex hormones

I wish to express my deep gratitude to Prof N C Nag formerly Asstt Director Bose Institute Calcutta for his direction and guidance and also for devising ways and means Sri D N Ganguly of the Dept of Zoology Calcutta University for preparing the microsections Prof S N Mukherjee of the Dept of Physical Chemistry College of Engineering and Technology for spectrophotometric analysis of the oil and Mr C C Saha and Mr J N Chakravorty of Messrs C C Saha Ltd for supplying necessary implements

S N SANYAL

Calcutta Bacteriological Institute
105 Vivekananda Road
Calcutta-6 12 8 1949

---

[1] Nag N C & Jain A K *Trans Bose Res Inst* 11 91 1935 36

[2] *Ibid* *Trans Bose Res Inst* 12 43 1936 37

[3] Allen E & Doisy E A *Jour Amer Med Assoc* 81 819 1923

[4] Cramer E *Amer Jour Cancer* 1937

GRAPHITE DEPOSIT OF ANARA, MANBHUM DISTRICT

Graphite—bearing rocks containing mostly flakes or lamellar scales of graphite are found scattered in the neighbourhood of Kolajori, Bongora and Jihurbona 3½ to 4 miles S S E of Anara Ry Stn on the Adra-Purulia line B N Ry in the Manbhum Dt of Bihar Anara is about 185 miles from Calcutta and most probably is within the operational area of the Damodar Valley development project

There are several indications of graphite bearing soil in the vicinity of Bongora to the field on the W N W of the village The *nullah* just on the E of the village contains numerous indications of graphite and the sources of graphite rocks can be traced all along the area following the *nullah* upto the Darakeshwar river on which the *nullah* is pouring its water About a furlong on the N N E of Bongora indications of flaky graphite are found in a pit of 12 to 15 ft in diameter, with a regular vein of about 3 ft in thickness, replacing the semi decomposed country rock composed of mica schist and quartzite The sample collected from the pit is of fairly good quality containing 60 per cent graphitic carbon The graphite indication are not continuous in character and seem to occur in isolated patches in the surrounding rocks

The country rock contains mica schists and quartzites of Dharwar age traversed by innumerable pegmatite veins in which milky quartz and flesh coloured fedspar occur Very few pegmatite veins contain mica but where found it is usually of very small size and of ruby variety The strike of the country rock is S S W—N N E and the pegmatites are cutting these almost parallelly, but in some places pegmatites are found cutting the mica-schists and quartzites obliquely The pegmatites are more common in soft decomposed schist-rock and the graphitic material appear to have penetrated the pegmatites and the contact of the intrusions into the softer schist-rock The graphitization is undoubtedly a post pegmatitic phase—graphite is usually noticed in the crushed zone of the pegmatite veins Wherever the graphitic emanations are noticed in the pegmatites the original quartz and feldspars are found to be in a very crushed and sheared condition The more common occurrence of graphite concentration is the soft and semi decomposed mica schist, where the carbonaceous matter favourably took shelter and ultimately got deposited in veins and lenticular pockets

Samples collected from the pit has got 2 7 sp gr It is contaminated with the decomposed country rock It gives about 55 to 60 per cent of graphitic carbon Samples collected from the *nullah* has got 2 3 sp gr and contains about 60 to 65 per cent graphitic carbon It is soft black, unctuous and resistant to chemical reagents and serves as a good lubricant

Graphite containing less than 80 per cent of graphitic carbon is difficult to find a ready market except perhaps for making paints However the percentage of carbon is not the sole criterion Other physical properties play an important role in appraising the quality of graphite, particularly the size of the flakes, toughness of the particle and the nature of impurities such as silica and mica, which are very difficult to eliminate in subsequent clearing operations without destroying the structure

Froth—flotation method was practiced on laboratory scale by using a mixture of cocoanut oil and kerosene (white refined variety) with about 100 grs of the crushed sample after passing through a 75 mesh sieve so that the flakes are not destroyed by fine grinding A very good amount of froth was formed after agitating the mixture and passing a current of compressed air from a cylinder The percentage of recovery was about 75 per cent

The veins containing graphite is increasing in breadth as we are getting down The present working face is at a depth of 40 ft , where a 4½ ft vein is being worked in the direction of strike as well as in the direction of dip.

S DEB

Engineering Geology Laboratory
College of Engineering and Technology
Jadavpur Calcutta 32
30 7 1949

---

[1] Economic Geology 1942 p 398

THE SPECTRO CHEMICAL ANALYSIS OF THE TRACE ELEMENTS IN THE CINCHONA LEAVES

The spectrum of the cinchona leaves ashes consist mostly of the lines of K, Ca, P, Mg, Si Na, Fe and Mn The intensities of the lines of these elements indicate that they are the major elements present in the ash The lines of Ba Sr Zn Cr and Cu are also found in the spectrum but as they are not very bright, these elements can be taken as the trace elements of the ash The major elements of the ash have been chemically analyzed The result of such an analysis is the following

K_2O 23 50% CaO 20 60% P_2O_5—15 30%
MgO—13 58% SiO_2 7 50% Na_2O— 4 20%
Al_2O_3 4 18% SO_2— 5 80% Fe_2O_3—0 71%
MnO— 0 67%

For estimating the trace elements spectrochemically standard samples of the ash have been synthetically prepared by first mixing together in an appropriate way the above ingredients and then adding to known amounts of the mixture different but suitable amounts of the trace elements mentioned above In this way synthetic ashes have been prepared containing 0 005, 0 01, 0 025, 0 05, 0 10 and 0 20 percentages of each of

Ba, Sr, Zn, Cr and Cu The spectra of these standards have been photographed on the same plate together with those of the actual ashes The percentages of the trace elements have then been determined in the usual way by taking the photometric measurements of the blackenings of the spectral lines The trace elements of the leaves of two years and seven years old plants have been determined and the following are the results

	Years old plants	7 Years old Plants
Zn	0 110%	0 093%
Ba	0 133%	0 153%
Sr	0 031%	0 0 5%
Cr	0 003%	0 005%
Cu	0 034%	0 025%

The details of this investigation will be published in the forthcoming issue of the *Transactions of the Bose Research Institute Calcutta*

K C Mazumdar
M K Ghosh

The New Control and Research Laboratory
Tatanagar 3 9 1949

THE ALKALOIDS OF *MAHONIA ACANTHIFOLIA* DON

Although Don[1] recognised in 1831 two distinct species of Indian *Mahonia viz M nepalensis* D C and *M acanthifolia* Don yet Hooker and Thomson[2] united all the species of *Mahonia* to *Berberis nepalensis* Spreng Fedde[3] however supported Don s view which was further corroborated in later years by Takeda[4] who pointed out the subtle morphological differences of *M nepalensis* D C and *M acanthifolia* Don The present writers support in the present work these differences by the phytochemical examinations of these two plants They separated from the roots of *M acanthifolia* altogether five alkaloids which were identified as oxyacanthine m p 216 in vac berberine (acetone compound of the base m p 167 69 decomp) palmatine (terahydropalmatine m p 142 43) jatrorrhizine (the iodide m p 210) and neprotine (the picrate m p 208 10 decomp) The isolation of the alkaloids pointed to *M acanthifolia* as distinct from *M nepalensis* for one of us Chatterjee[6] could isolate only two alkaloids umbellatine and neprotine from the roots of *M nepalensis* growing side by side with *M acanthifolia* in Darjeeling

Though present in a very small quantity neprotine, the new alkaloid is found to be common to the Indian species of *Mahonia* It is interesting to note that palmatine has been reported for the first time from a species of *Mahonia*

The authors are indebted to Dr S K Mukherjee Curator of the Herbarium Royal Botanic Gardens Calcutta for identifying the specimens of *M acanthifolia* and *M nepalensis* used in these experiments and to Dr N K Sen Professor and Head of the Department of Chemistry for providing laboratory facilities

R Chatterjee
M P Guha

Presidency College
Calcutta
3 9 1949

Don 1 *General System of Gardening and Botany* 1 118 1831

Hooker et Thomson *Flora Indica* 1 219 1855

Fedde *Engler s Bot Jahrbuch* 31 124 1901

Takeda *Notes Bot Gard Edin* 6 209 1911 17

Chatterjee *J Amer Pharm Assoc* 33 210 1944

COLORIMETRIC ESTIMATION OF IRON

The reagent quinaldinic acid was used by Roy and Bose[1] for the gravimetric estimation of Copper Cadmium Zinc etc They further found that the reagent may also be utilised for the colorimetric estimation of Ferrous iron which with the reagent forms a red coloured complex This complex dissolves in excess of cyanide which again intensifies the colour With the help of Lumetron Photoelectric colorimeter and Fluorescencemeter of model 402 EF the maximum absorption due to the coloured system formed by adding the reagent (Na salt) to a ferrous salt solution is found to be in the region of 515 mμ Though Cyanide intensifies the colour the maximum absorption region is not found to be shifted thereby even when a large excess of Cyanide is used Similar effect is noticed with an excess of the reagent Reducing agents such as Hydroxylamine Hydrochloride Hydrazine Sulphate Hydrogen Sulphide etc are also found to have no influence on the region of maximum absorption The coloured system was found to obey Beer s Law In a volume of 25 c c not more than 1×10^{-4}g of iron (ous) should be estimated in a cell of thickness 20 m m and capacity 16 m l as with a greater amount the colour developed is too intense to be measured With a colorimeter of the Duboscq type iron up to the extent of 10^{-3}g can be estimated and the minimum limit that can be accurately estimated is found to be 2γ in a volume of 5 c c The effects of acids and other anions and cations have also been studied

Buddhadev Sen
Anil Kumar Majumdar

Inorganic Chemistry Laboratory
College of Engineering and Technology
Jadavpur Calcutta 32
13-8 1949

[1] Roy and Bose *Z Anal Chem* 95 400 1933

BOOK REVIEWS

A Community at the Cross Road—By S F Desai Published by the New Book Co Ltd Bombay 1948 Pp 201 Price Rs 10

Students of social sciences will always welcome books of such nature which deal with the demographic studies of different communities This book deals mainly with the problems of Population Fertility Housing and Health conditions of the Parsi community together with their cultural heritage before coming to India

Regarding the inadequateness of the data on which the present work is based the writer has himself said I have endeavoured to give in this book some idea of the problems facing the community but an effort on a larger scale is necessary As a preliminary to that proper data must be available and they can be had only from Census Reports which are at best inadequate in that regard Further he has written while no reliable data are available for the Parsis it would appear from all circumstantial evidence that fertility is falling

It is very unscientific now a days to say about superiority or inferiority of a race and still more worse when a student of science advocates to preserve the so called superiority of a community at any cost The writer himself a Parsi suffers from this complex when he writes The parsis have ethnologically kept themselves aloof from the main Indian population which is the one reason why their traits are still to be found as a complex herited from their great ancestors The present day Parsi must therefore strain every nerve to preserve them and hand them down to posterity

On the whole the writer s preliminary efforts are praiseworthy The students of social sciences will be much grateful to him if he can carry out a sample survey regarding the socio-biological conditions of the Parsi community of Bombay by means of Random Sampling Method which is at present the scientific method for carrying out any kind of survey

Like the author we shall be glad to see that this book acts as an eye opener to the Parsi community which according to the author is at the Cross Road

G R

The Cytoplasm of the Plant Cell—By the late Dr A Guilliermond *Foreword* by William Seifriz Published by the Chronica Botanica Co Waltham Mass U S A Macmillan & Co, Ltd Calcutta 1941 (Second printing 1948) Price $5 0 0

The present volume under review is the translation of an unpublished French manuscript of Prof Guilliermond, and the translator Mrs Atkinson has added much to its value by her original interpretations on the subject

As vast amount of literature has accumulated in recent years on Mitochondria Chloroplasts Amyloplasts Plastids etc most of which are scattered in different journals and quite contradictory in nature it is a pleasure to find all these presented in a nice and precise way in the volume under review As in recent years considerable progress has been made regarding the physical constitution of the Cytoplasm and as its morphological constitution is definitely clarified the need of such a publication has keenly been felt by those interested in this particular aspect of study

An attempt has been made here to set forth all the facts now known concerning the nature of the Cytoplasm and the considerable progress that has been made during the last years with regard to this important question A thorough and masterly analysis of all the theories regarding the nature of the writer s own observations forms the main theme of the book

One of the most attractive features of the volume is the unbiased and illuminating discussion regarding the histochemical nature of the vacuoles and vacuolar systems as well as regarding the reality of the fact that mitochondria are not artefacts and their significance in the life of the cell During his discourse to prove the reality of the Chondriosomes and its significance in the life the cell Prof Guillermond gives evidence of his unprejudiced and unemotional nature by discarding the view that Chondriosomes are the means by which every synthesis in the cell takes place Moreover in the concluding part of the chapter he as a true scientist admits about the incomplete knowledge regarding the function of Mitochondria and does not hastily draw any conclusion

The problem regarding the nature of the Protoplasm has been very ably dealt with and the conclusions drawn by the author from his own researches leaves no doubt to the reader s mind regarding the basic solid nature and the structural continuity of the Protoplasm During the discussion of various theories regarding the nature of Cytoplasm Plastics etc, neither the morphological nor the physico chemical point of view has been neglected The necessity of the union of Morphology and Physiology in building up the future of Cytology has been rightly stressed with In the last chapter Prof Guilliermond summarises the various topics dealt with in a very precise way including all the relevant points in it The introductory chapter deals with a systematic historical sketch of the study of Cytoplasm and the difficulties for the study has also been lucidly discussed The methods that have been recommended by the author for this purpose are extremely helpful to workers engaged in this particular line of research.

One particular point that often strikes a reader is the absence of any discussion, in such a volume on Cytoplasmic inheritance, the subject which has attained considerable importance during the last few years An addition of a chapter dealing with this particular subject in the next edition will be much appreciated, thus making the volume a perfect one

However the book, giving all the up-to date available facts and outlining ways for future research would be extremely helpful to one and all interested in the subject ' It is well indexed, nicely got up and devserves a place in any of the scientific libraries

A K S

Elementary Structural Analysis –By J B Wilbur Sc D and C H Norris Sc D , McGraw Hill Book Co., New York and London Cloth 6″ × 9″, Pp x + 523, 1948, Price $ 6 00

Ever since Charles Augustin Coulomb laid the foundations of structural theory some eighteen decades ago, the modern principles of structural analysis have been propounded and published in a large number of texts The present work written by a Professor and Head of the Department of Civil Engineering and an Assoc Professor of Structural Engineering of M I T , deals with the relationship of structural theory to applied mechanics and the application of its basic principles to a variety of engineering structures

The first six chapters deal with the general elementary principles of applied mechanics viz loading of structures, reactions shear and bending moments graphic statics, and influence lines, while bridges, roof trusses and long span structures are introduced in the next two chapters The principles of three dimensional frames, gravity structures and cables are dealt with in chapters 9 to 11 Thereafter a survey is made of the fundamentals of statically indeterminate structures, their influence lines and deflections Chapter 16, appears to be the most interesting and one usually not found in texts on structural engineering It deals with the general stress analysis of aeronautical marine and chemical engineering structures, and vividly shows the student of civil engineering that the methods of analysis he employs are also applicable in practice to a large variety of structures lying outside his field The last three chapters cover model analysis and describe Begg's Deformeter, photoelasticity and other general experimental methods of stress computation

The admirable feature of the text is that it surveys the field of structural analysis with a wealth of illustrative examples, and in an unusually clear and lucid manner, enabling the reader to grasp the subject from its basic theoretical principles, down its practical applications The publication of "The Factor Method," of analyzing building frames acted upon by lateral loads, developed by the senior author, appears in this text for the first time This method, based on the slope deflection method is more accurate than either the portal or cantilever method of analysis and should prove of much use in designing work Nomenclatured as Elementary Structural Analysis,' this book covers a much wider field, as it deals with the advanced analysis of statically indeterminate structures and hence can be profitably read by a student of structural engineering as well as by a designing engineer who wishes to keep himself abreast of the modern design methods

The difficulty of drawing a clear border line between an elementary and advanced work on a wider subject like structural analysis has to a certain extent resulted in the omission of some useful details Thus Southwell's method of systematic relaxation, (R V Southwell, 'Relaxation Methods in Engineering Science', Oxford, 1940), and the principles of elastic energy theory and limit design (J A Van den Broek, 'Elastic Energy Theory, 1942, and "Theory of Limit Design' 1948, Wiley) do not appear to have received any recognition In trying to amass a wealth of information on the diverse branches of theory, the authors have omitted the discussion on an elementary and important subject like column analysis It was some 200 years ago that that great Swiss mathematician, Leonard Euler, empirically made the assumption that in a rod the bending moment at any point is inversely proportional to the radius of curvature of the effective elastic axis As Euler's exposition was basically influenced by Bernoulli's speculations, the theory of bending of rods came to be adopted as the Bernoulli Euler theory Today in spite of the refinements in design and the introduction of tangent and secant modulus conceptions (used for plastic range problems), the basic equations of Euler hold good and form the stepping stone for column analysis This subject has now become so vast and complicated that there is hardly a treatise on structural analysis,—elementary or advanced —which does not deal with the varigated aspects of column design Its absence, therefore in this text appears to be a rather important gap, especially when it is noted that in the seven page Index at the end, even the name of Euler is not given The economy and efficiency in designing is now recognised in the development of the theory of plasticity and as such a digress on this subject would have further enhanced the value of this work In model analysis, the stress coat or lacquer coat method of strain determination and the mechanical interferometry methods of observing the elastic and plastic deformations of a structure (recently developed at the Naval Ordnance Laboratory, Washington,) form two of the most modern methods in this field, none of which unfortunately are described in the text On page 353, the underlying principles of cambering a structure are examined, and illustrated by means of an example of a truss The prestressing principles involved herein should have been better explained with reference to reinforced concrete work where they are now largely employed In addition to the worked-out examples, there are a number of problems given without answers Their value would have increased, if answers to the problems involving arithmetical computation were given as the reviewer believes that a student usually finds greater relish in solving problems wherein the correctness is known from the answers, than otherwise

The book, in spite of some shortcomings, fully accomplishes the aim of the authors and forms a valuable treatise on the subject of structural analysis in which the elementary and advanced principles are harmoniously blended together with a modern and refreshing outlook

S K G

The Geography of the Flowering Plants—By Ronald Good Illustrated by 71 line drawings, 9 maps in colour and 16 photogravure plates Published by Longmans, Green & Co, London in 1947 Price 30 shillings net

This book is a complement to the two other books published recently on the same subjects—'An Introduction to Historical Plant Geography' by E V Wulf published in 1943 by Chronica Botanica, Waltham, Mass and 'Foundations of Plant Geography' by S A Cain, published in 1944 The publication of these three books, during recent years revives the interest in studies in Plant Geography, as research workers on this subject were previously considerably handicapped due to want of available literature in English, which were mostly in German

The two previous books deal elaborately with the methods of investigation in Plant Geography as also on the processes and factors responsible in the evolution of the plant kingdom The present book is a valuable publication in Plant Geography as in addition to a discussion on the above subjects, the author has compiled exhaustive data on the distribution of the various categories of the plant kingdom After a preliminary discussion on the 'Geography of the World' dealing with the distribution of Continents and Oceans, islands, mountains and deserts occurring throughout the world, he has discussed in detail with figures—(1) number and size of plant families as also the distribution of 'wide,' 'tropical,' 'temperate,' 'discontinuous,' 'eudemic,' 'amomalous,' and 'southern' families (2) distribution of genera dealing with number and size of genera, 'cosmopolitan tropical,' 'temperate,' 'discontinous,' 'endemic' genera, (3) similar treatment on distribution of the species

The detailed figures given in the above chapters will greatly help the workers in Plant Geography in finding out relevant statistics on the distribution of the families, genera and species in various parts of the world It will also open up to the research workers the interesting facts about the distribution of these various categories which will induce them to a critical analysis of the causes and factors responsible for such distribution

In the second part of the book the author has discussed about the various factors responsible for the distribution of the plants and has finally put forward his ' Theory of Tolerance "

The maps showing the distribution of the various climatic factors throughout the world, the division of the earth s surface into grassland, forest, savannah etc and particularly the one delimiting the world into Floristic Regions' will be very useful

Due to the weather of data on the distribution of the various families, genera and species and a discussion of important features of such distribution, accumulated in this book, it will be a valuable acquisition in the libraries of the various universities and research institutes for workers in Plant Geography and Taxonomy

SCIENCE AND CULTURE

A Monthly Journal of Natural and Cultural Sciences

Vol. 15 NOVEMBER 1949 No. 5

UN AND WORLD PEACE[*]

THE Charter of the United Nations Organization came into force four years ago on October 24, 1949 On this day the nations of the world solemnly pledged themselves to save succeeding generations from the scourge of war and embarked on a new adventure and experiment in world government, based on a firm faith in fundamental human rights, in the dignity and worth of the human person, in the equal rights of men and women and of nations large and small It is appropriate that the nations of the world should have decided to celebrate this day and express their faith in the noble ideals and purposes for which the UN stands

India has always been a firm believer in the high principles of economic, social, educational and political co operation laid down in the UN Charter By her election to the Security Council, India has been enabled to play a vital rôle in world affairs Proper appreciation of the purposes and functions of the UNO on the part of members of all sections and communities is highly desirable if this country is to effectively contribute to the success of this organisation

THE GENERAL ASSEMBLY

At the centre of the UN Organization is the General Assembly composed of representatives of all member nations which at present total 65 Each member State can delegate up to a maximum of five members, with only one vote for each State Unlike the assemblies or general conferences of other international organizations, the UN General Assembly, it is important to note, is by no means a supreme body responsible for all the UN activities In the social, economic and cultural spheres, in matters relating to the administration of trust areas and in preparing budgets and allocating funds, the General Assembly has indeed exclusive powers and authority, and in that capacity, controls the activities of the Economic and Social Council (ECOSOC) and the Trusteeship Council But the responsibility of action for the all important question of maintaining international peace and security and of taking effective measures against the offending State, belongs to the Security Council Likewise, the International Court of Justice is supreme in its own judicial field

This delimitation of authority as between the Assembly and the Security Council in respect of international security is largely the result of unfortunate experience of the League of Nations The Covenant of the League provided, like the Charter of the United Nations, for the establishment of two bodies, the Assembly and the Council, and made it possible for both the bodies to deal with disputes and vital questions relating to security simultaneously and separately This vagueness and sharing of responsibility frequently led to endless discussions, dangerous procrastination and a tendency to shift responsibility from one body to the other in delicate matters

This time the framers of the Charter at San Francisco were therefore careful in advoiding a repetition of the past mistakes and made the Security Council an all powerful and effective organ of the United Nations to deal with matters affecting peace and security It is pertinent to remark here that the small nations who were thus deprived of playing any effective rôle in questions of war or peace, naturally enough strongly resented and opposed such curtailment of powers of the Assembly which was to all intents and purposes reduced to a debating platform

---

[*] Based on a talk delivered by Sri S. N. Sen at the Asansol, Rotary Club on the occasion of the UN Week.

Economic and Social Council

We have already spoken of the General Assembly's exclusive responsibilities in respect of economic, social and cultural matters The emphasis, in the UN Charter, on the need of developing economic, social, cultural and other humanitarian relations among nations, as a prelude to strengthening the foundation of a peaceful world society, is really unique in the history of international organization The finely worded articles defining the responsibilities and functions of the UN in these respects are worth quoting

> "With a view to the creation of conditions of stability and well being which are necessary for peaceful and friendly relations among nations based on respect for the principle of equal rights and self determination of peoples, the United Nations shall promote:
>
> (a) Higher standards of living full employment and conditions of economic and social progress and development,
>
> (b) Solutions of international economic, social health and related problems, and international cultural and educational co-operation, and
>
> (c) Universal respect for, and observance of, human rights and fundamental freedoms for all without distinction as to race, sex, language or religion.'

Now, the League of Nations did also realize the necessity of engaging in activities calculated to promote better social and economic understanding on an international level Thus Article 23 of the Covenant laid down that 'the Members of the League will endeavour to secure and maintain fair and humane conditions of labour for men, women and children, both in their own countries and in all countries to which their commercial and industrial relations extend, and for that purpose will establish and maintain the necessary international organizations' This was a clear directive for the creation of the International Labour Organization (ILO) which came into existence in 1919, with its headquarters in Geneva, very near the Palais des Nations, and had the main task of framing international rules on conditions of labour, of pursuading governments to accept these rules and of supervising their applications The ILO also dealt with the questions of hours of work, unemployment, employment of nursing mothers and pregnant women, minimum wages for child workers, workmen's compensation, sickness insurance, protection against accidents and a variety of related subjects The ILO had a very good record of work in its limited field between the wars.

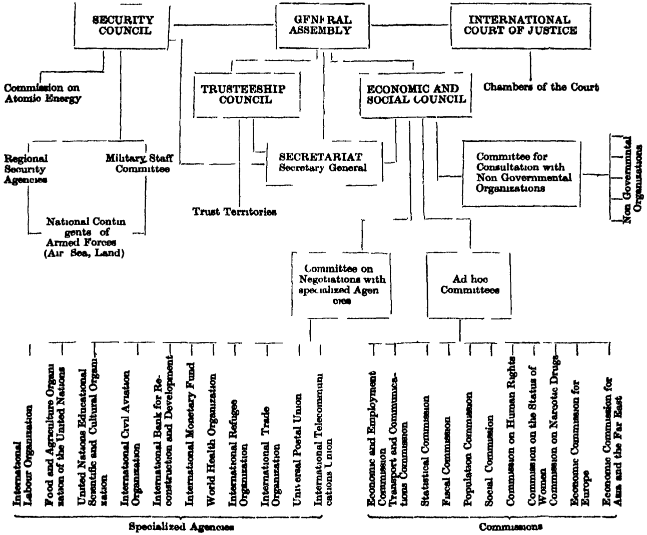
The ILO is, however, not the only instance of the League's non-political activities It established the International Health Organization by another provision in the same article which provided that the League should 'take steps in matters of international concern for the prevention and control of diseases' The League also exerted beneficial control on the traffic in opium and other dangerous drugs

The United Nations have inherited all these activities of the former League of Nations and have embarked upon much wider economic and sociological adventures than could ever be contemplated For instance, a very bold and unparalleled step was taken when educational, scientific and cultural matters were made subject of international concern, study and advice The creation of UNESCO marked the practical realization of the ideal that, since wars originate in the minds of men, it is in the minds of men that the defences of peace shall have to be built up. What is very important is that some of the specialized agencies having avowed intentions of promoting peaceful co-operation and development in such fields as post-war relief and rehabilitation, food and agriculture, world finance, banking and reconstruction, education etc started independently and much before the politicians could get together to agree or agree to disagree on the future patterns of international political activities Thus the world food and agricultural specialists conferred at Hot Springs, Virginia, in February 1943, and laid the foundation of the Food and Agriculture Organization World's 400 monetary and financial experts met at Bretton Woods in July 1944 to consider how best to 'reduce obstacles to international trade and in other ways promote mutually advantageous international commercial relations . and facilitate by co operative effort the harmonization of national policies of Member States designed to promote and maintain high levels of employment and progressive rising standards of living' The United Nations' plan for educational, scientific and cultural co operation were outlined in 1942 by the Allied Ministers of Education of the various European governments then exiled in London And so on This early mobilization of the world's economic and sociological, food and agricultural financial, educational, scientific and cultural and other humanitarian interests was primarily responsible for the extension and emphasis of the Charter's non political and peaceful provisions for co operation

The various specialized agencies affiliated to the Economic and Social Council do not by any means exhaust the activities of the Council The Council has set up a number of expert commissions, of which special mention may be made of the Commission on Human Rights, the Economic and Employment Commission, the Statistical Commission, the Commission on Narcotic Drugs, the Transport & Communications Commission, the Population Commission, a Fiscal Commission Economic Commission for Europe, Economic, Commission for Asia and the Far East etc Some of these Commissions are doing excellent work of permanent international value

The work of the Economic and Social Council is, however, not without limitations. The Council can only make recommendations to adhering member States, but cannot make it obligatory for them to execute the Council's programmes Most of the Council's work is of an exploratory, fact-finding and advisory nature and not of a concrete developmental type. The routine work of the specialized agencies, in the last analysis, consists in calling almost an endless series of expert conferences, committees, sub committees etc , blackening tons of paper to turn out thousands of mimeographed reports in several languages and in flooding with them the desks of individuals and organizations Never has the world seen such a spate of international conferences and memoranda and reports, printed or mimeographed, as now For instance, in the month of March, 1949 alone, there were held as many as 14 international conferences and meetings all in Paris There is a just feeling in many quarters that the UN and the UN agencies should by now learn to talk less and act more

CHART SHOWING UNITED NATIONS ORGANIZATION


SECURITY COUNCIL
GENERAL ASSEMBLY
INTERNATIONAL COURT OF JUSTICE
Commission on Atomic Energy
TRUSTEESHIP COUNCIL
ECONOMIC AND SOCIAL COUNCIL
Chambers of the Court
Regional Security Agencies
Military Staff Committee
SECRETARIAT Secretary General
Committee for Consultation with Non Governmental Organizations
Non Governmental Organizations
Trust Territories
National Contingents of Armed Forces (Air Sea, Land)
Committee on Negotiations with specialized Agencies
Ad hoc Committees
International Labour Organization
Food and Agriculture Organization of the United Nations
United Nations Educational Scientific and Cultural Organization
International Civil Aviation Organization
International Bank for Reconstruction and Development
International Monetary Fund
World Health Organization
International Refugee Organization
International Trade Organization
Universal Postal Union
International Telecommunications Union
Economic and Employment Commission
Transport and Communications Commission
Statistical Commission
Fiscal Commission
Population Commission
Social Commission
Commission on Human Rights
Commission on the Status of Women
Commission on Narcotic Drugs
Economic Commission for Europe
Economic Commission for Asia and the Far East
Specialized Agencies
Commissions

THE SECURITY COUNCIL

The Security Council, the principal and the most important organ of the United Nations, has the key functions and responsibilities of the United Nations to perform, namely the maintenance of world peace and security It is a small body of eleven members, of whom five great powers the U S A , the U S S R. the United Kingdom, France and China are permanent members The six non permanent members have a term of office for two years and are elected by the General Assembly The Security Council, with its wide powers and responsibilities, is perhaps the smallest single body on which the nations of the world have ever agreed to place their fate

The League of Nations had also a similar Council having the same purposes, if not the same powers and responsibilities It seems therefore appropriate to compare the principal differences between these two bodies The long and old study of international situations threatening peace and eventually precipitating war has convincingly shown that any international agency, charged with the responsibility of maintaining peace and security, to be really effective, must have powers of quick decisions and the means, economic or military or both, to implement these decisions This speed and strength are two essential prerequisites of success of any such international agency This speed and strength the old League Council did not possess to any sufficient or effective degree For instance, the League Council was unable to take initiative in a situation endangering peace and also powerless in a situation in which war was slowly but inexorably approaching When an actual state of war existed the Council could indeed discuss the situation, make post mortem examination of the causes leading to the out break of the war and impose sanctions against the aggressor nation Moreover, the Council and the Assembly had divided responsibility in matters of security, which involved endless delay in making important decisions

The Security Council, on the other hand, has full powers to take up for consideration any question involving a threat to peace Any member of the Council, or of the General Assembly, or of any State, or the Secretary General himself on his own initiative can request such consideration This power of the Secretary General is very important because of the possible and natural reluctance of member nations to get involved in unpleasant questions In fact, the Charter makes it clear that the Security Council should be always on the guard that no dangerous situation should arise and, if it arises at all, it should by no means be allowed to deteriorate through lack of proper attention and prompt adequate measures Wide powers have been given to the Council to investigate any dispute or any situation which might lead to international friction or give rise to a dispute, and use such powers without reference to the Assembly or any other authority in the world

The ability to decide quickly whether a threat to peace exists or not becomes of little importance unless the Council has at the same time adequate powers and means to meet and remove this threat, *i e*, unless it has teeth in it The Charter provided the Security Council with the teeth This threat might be removed either by economic pressure or by military pressure, depending on the gravity of the case The Council can propose economic pressure in the form of 'complete or partial interruption of economic relations and of rail, sea, air, postal, telegraphic, radio, and other means of communication, and the severance of diplomatic relations' (Article 41) Where armed action is needed, the Council can authorize 'such action by air, sea or land forces as may be necessary to maintain or restore international peace or security' which 'may include demonstration, blockade and other operations by air, sea or land forces of Members of the United Nations' (Article 42) In such emergencies, the Member nations are also bound to provide contingents of their armed forces To advise the Council on military questions and on questions of regional securities, the Council has constituted a Military Staff Committee and Regional Security Agencies

THE VETO PROBLEM

It would thus appear that, after the creation of such a powerful and effective international instrument for maintaining peace and security, the world should have had no fears and should have been able to live in a sense of perpetual peace Perhaps this utopian dream would have nearly materialized this time had it not been for the unanimity rule or veto provision in the Charter of the Council, which has been the subject of so much controversy during recent years All decisions of the Security Council shall have to be made by the affirmative vote of seven members including the concurring vote of the five permanent members The veto power shall not, however, be exercised in procedural matters, nor by a member who happens to be a party to a dispute The ruling on voting is contained in Article 27 which runs as follows

> 1) Each member of the Security Council shall have one vote
>
> 2) Decisions of the Security Council on procedural matters shall be made by an affirmative vote of seven members
>
> 3) Decisions of the Security Council on all other matters shall be made by an affirmative vote of seven members including the concurring votes of the permanent members provided that in decisions under Chapter VI and under paragraph 3 of Article 52 a party to a dispute shall abstain from voting

This unanimity principle or the power of veto means that any one of the permanent members of the Council can block any decision even if it is unanimously arrived at by all the remaining members This special privilege granted to the Great Powers strikes at the very root of the equality of nations upheld in the Charter Moreover, the veto power may be interpreted as has indeed been done by the opponents of this provision as indirectly granting to the Great Powers the right to violate the Charter in circumstances distasteful to them and protecting them from the consequences

The veto powers had to be provided for on the insistence of the Great Powers At the Yalta Conference in February, 1945, President Roosevelt, Marshall Stalin and Mr Churchill agreed that the unanimity principle would be indispensable if the Great Powers were to bind themselves with the obligations laid down in the Charter and commit their armed forces for use by the Security Council They contended that, in the present state of affairs, the world peace and security could be assured only by the armed strength of the Great Powers, therefore, the ability of the Great Powers to make joint decisions must be a *sine qua non* of the Council's work Failure to incorporate this provision would be a standing invitation to the danger of the Great Powers' leaving the UN and thus rendering it ineffective and useless as it happened in the case of the League of Nations

The veto question has been strongly criticized on several occasions beginning with the San Francisco conference The frequent exercise of this power by the Soviet Union—and they have exercised it to block important decisions on 40 occasions so far according to a recent press note, has led to a strong feeling in many quarters that, either an abolition of the unanimity rule or its substantial modification is now necessary if the UN is to work as it should The question came up for sharp discussion in connection with the work of the Atomic Energy Commission The American plan known as the Baruch Plan which was supported by all other members of the Commission excepting Soviet Union and Poland, emphatically proposed that the veto power should not apply to questions involving violations of the atomic power agreement Needless to say that the Soviet Union did not agree to this plan At the last meeting of the General Assembly held in Paris, the Western Powers again expressed themselves strongly in favour of doing away with the veto power

Before concluding we would venture a few remarks on the prospects of the UN Shall UN succeed or fail ? The events which have taken place since San Francisco are far from inspiring confidence among nations The way the UN handled problems in Greece, Korea, Palestine Kashmir, the atomic energy question and many other problems is simply disappointing Then the question of Berlin and therefore the future of Germany remains largely unsolved Even the peace treaty with the former enemy countries has not been signed Meanwhile, the world has been divided into two rival and irreconcilable power blocks on ideological grounds, with perhaps comparable military potential On the one hand, there is the Soviet Union, with the largest standing army in the world together with atomic weapons in their arsenal, to which are allied other Eastern European countries who believe in the Soviet political and sociological philosophy on the other end lies the U S A long since armed with atomic weapons and having great industrial and war potential to which have combined bankrupt western powers both for reasons of common political outlook, but more specially, for indispensable dollar aid to help build their shattered economy In this set up there is no more any question of the old balance of power This polar concentration of power is unparalleled in history and has given rise to an entirely new situation which, frankly speaking, the UN or any similarly constituted body is incapable of dealing with We believe that a fundamentally different approach involving a radical change in the composition, representation, voting procedure etc would be necessary to solve this impasse It is a big and difficult job for specialists in international government to undertake and has to be done sooner the better Alternative to making the UN work satisfactorily is progressive and inevitable deterioration of international situation and the eventual certainty of another World War in which civilization may completely perish

---

POLYMERIZATION IN SUSPENSION

W P HOHENTEIN AND SHAM LAL KAPUR,

POLYMER RESEARCH INSTITUTE, POLYTECHNIC INSTITUTE OF BROOKLYN NEW YORK

IT is generally known that the polymerization of vinyl type monomers $CH_2 = CHX$ or of diene type monomers $-CH = CH - CH = CH -$ leads to the formation of molecules of a high average molecular weight Such polymeric materials have attained major industrial importance and the manufacture of plastics and synthetic elastomers (rubbers) has become one of the most important operations of the chemical industry in the USA and in other highly industrialized countries.

The polymerization reaction, i e , the conversion of the liquid or gaseous monomers into rigid or flexible plastic or elastomeric materials, can be carried out either in a homogeneous phase (bulk and solution polymerizations) or in a heterogeneous phase, (emulsion and suspension polymerization) Both types of reactions have found application in scientific investigations and also in manufacturing processes However, for reasons of technical and economical nature, the reactions in the heterogeneous phase have proved to be of considerable greater advantage in large scale industrial operations

A comparison of the pertinent facts of the various polymerization methods easily explains this very noticeable trend towards emulsion and suspension polymerization If a polymerization reaction is carried out in bulk, i e , the liquid or gaseous monomer is heated directly in the presence of a catalyst, then the exothermic polymerization reaction quickly raises the temperature to a point where it cannot be any more efficiently controlled, the reaction subsequently gets out of hand In order to avoid general and local overheating, elaborate cooling systems have to be installed to dissipate the heat of the reaction (approx 20,000 cal/mol), or the reaction has to be carried out at low temperatures and over long periods of time This makes the bulk polymerization method a rather cumbersome and expensive operation and it becomes uneconomical for large scale manufacture In addition to the difficulties involved in the heat control of the process, an analysis of the polymer obtained by this method shows a wide distribution curve of molecular weights This in turn impairs some of the physical and mechanical properties of the finished material

In order to overcome the difficult heat control encountered in the bulk polymerization method, the monomers are dissolved in a suitable solvent and the solution is exposed to polymerization conditions The heat of the reaction is thus efficiently dissipated over the whole system and local overheating is held to a minimum However, the method of solution polymerization also exhibits some disadvantages, such as a slow rate of reaction and a comparatively low average molecular weight of the resulting polymer Besides it is difficult and expensive to remove the last traces of the solvent from the finished polymer Taking these reasons into account, it is understandable that the solution polymerization is very rarely employed as a technical polymerization method

In contradistinction to the 2 methods of polymerization in a homogeneous system, the polymerization reactions in heterogeneous systems, result in the formation of polymers of medium to very high molecular weight in comparatively fast reactions, without any difficulties in the heat control of the processes Specifically, the polymerization in emulsion gives a polymer of high molecular weight in a very fast reaction, while the polymerization in suspension results in polymers of a molecular weight slightly higher than those of a bulk polymer However, it was found that the distribution curve of the molecular weights is a much narrower one for a suspension polymer than for a bulk polymer To illustrate the differences in the rate of the reactions and also to show a comparison of the molecular weights of the polymers obtained by the various methods, Table I lists some comparative data

Fig 1 Globular Products obtained by Suspension Polymerization

TABLE I

POLYMERIZATION IN BULK IN EMULSION AND IN SUSPENSION

Method of Polymerization	Conversion	Viscosity average mol wt.
	%	
Bulk	53 9	40 000
Emulsion	90 6	370 000
Suspension	48 0	67 000

Monomer Styrene
Reaction time 2 hours
Temperature 85°C
Catalyst in emulsion : 0.5% Potassium persulfate
Catalyst in bulk and Suspension : 0 5% Benzoyl peroxide

From these data it would appear that the emulsion polymerization is the most desirable of the 3 possible methods of polymerization While this is true for some applications, it was found that in many cases this method is at a disadvantage compared with the suspension polymerization because the polymers obtained in an emulsion do not show the degree o purity and clarity as those resulting from a suspension polymerization The reason becomes obvious if one considers the two different reaction technics In an emulsion polymerization the monomer is dispersed into small particles with the aid of a surface active emulsification agent, usually soap The soap molecules adhere closely to the surface of the monomer spheres and also, when the reaction is completed to the surface of the polymer particles Since these have an average size of about 0 1–0 2 microns, they must be coagulated in order to give a workable material Thus the soap is incorporated inside the larger coagulated particles and cannot be completely removed by commercial washing or floating operations The presence of these traces of soap in the polymer causes it to be inferior in its optical and electrical properties if it is compared to the pure polymer

In a suspension polymerization there is no necessity of the coagulation step There the monomers are dispersed in the aqueous medium by efficient agitation and no surface active agent is present The size of the dispersed particles range from ½mm to 5 mm and the finished polymer appears in the form of quite uniform spheres (pearls) in the same size range Since this is already a workable size and no further agglomeration is necessary, the polymer possesses a far higher degree of purity than one prepared in emulsion (Figs. 1 and 2)

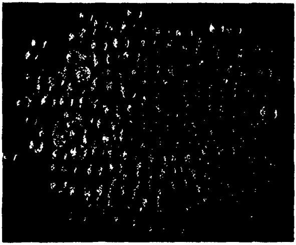


Fig 2 Styrene "Pearls' of varying Degrees of Transparency.

In general it can, therefore, be stated, that the two methods of polymerization in heterogeneous media are superior to the homogeneous phase polymerizations and that the proper choice between them depends largely upon the final application of the polymer If a pure material of high clarity and excellent electrical properties is desired then the polymer is made in suspension If, however, emphasis is laid upon very high molecular weight, then the emulsion method is preferable

MECHANISM OF SUSPENSION POLYMERIZATION

It is generally recognized that polymerizations of vinyl monomers proceed according to the mechanism of a chain reaction As such they can be characterized by the 3 logical steps of a chain reaction *viz*, (1) the activation of the chain (2) the propagation (growth) of the chain, and (3) the termination of the chain

In addition to these 3 general steps of a chain reaction, there are other processes, such as chain transfer, branching of the chain, cross linking of chains, which are specific for polymerizations They are responsible for the formation of more complicated macromolecules, which are often produced instead or besides simple chain like polymeric molecules

The mechanism and kinetics of the steps of polymerization reactions have been investigated and some definite conclusions have been reached for polymerizations carried out in a homogeneous system [1-4] As for reactions carried out in the heterogeneous systems of emulsions or suspensions, the mechanism of an emulsion polymerization is still a controversial issue[5, 6] while the mechanism of a polymerization in suspension appears to be established by a series of investigations cited below [7]

The principle of a polymerization in suspension consists in dispersing a liquid monomer in a non solvent medium (mostly water or aqueous solutions) by efficient mechanical agitation The whole system, containing the monomer in the form of liquid globules, is heated in the presence of a catalyst and the resulting polymer appears in the form of spheres ("pearls") It was found that mechanical agitation alone was not sufficient to prevent the globules from coalescing at a certain stage during the reaction It is therefore necessary to add certain substances to the reaction system, which act as suspension stabilizers and prevent agglomeration Several patents describe and protect the use of such stabilizers[8-11] which may be of organic or inorganic origin Their common characteristic is that they do not stick permanently to the surface of the polymer globules (as soap and other surface active agents do) but can be easily removed at the end of the reaction by commercial washing and filtering processes

EXPERIMENTAL CONDITIONS

To carry out a suspension polymerization in the laboratory, a rather simple experimental arrangement can be employed The polymerization can be carried out in a three neck flask equipped with a vapor tight stirrer, condenser, and thermometer This type of equipment can only be used for monomers which boil considerably above the temperature of the reaction For the polymerization of lower boiling or of gaseous monomers, electrically heated autoclaves on a shaking or rocking machine are used

A variety of chemicals can be employed as stabilizers for a suspension polymerization Among the best are inorganic hydroxides and salts certain types of polymers, gelatine starch, talc, etc Inefficient stabilizers favor the formation of large globules and agglomerated lumps even if used in comparatively large quantities Efficient stabilizers yield small, regularly formed spheres, quite uniform in size throughout the reaction bath The quantities of stabilizers which have to be used in order to achieve a certain desired 'pearl size vary not only with the efficiency of the stabilizer, but are also dependent on the specific reaction conditions employed By carefully balancing the effect of the various factors, such as stirring, temperature monomer water ratio, etc, the amounts of stabilizers employed can be very small For instance, as little as 0 1 per cent on the total system of an efficient stabilizer may give a most satisfactory result if the other reaction factors are adjusted accordingly Table II illustrates some formulations and their respective merits

TABLE II

(Styrene 50 gm water 300 gm catalyst, 1 percent Temp, 90 95°C, Time, 6 hrs.)

Stabilizer	Wt on monomers %	Globular size mm
Talc	0 8	1
P Vinyl alcohol	0 5	3
Gelatine	0 8	2
Bentonite	3 0	3
Mag Carbonate	0 2	1 5

Catalysts, or rather initiators or activators, indicated for this method of polymerization are mainly of 2 types namely, hydrocarbon soluble organic peroxides, and water soluble inorganic peroxides or salts of peracids It was observed that contrary to the experiences with emulsion polymerization the hydrocarbon soluble types proved distinctively more effective (Table III) A series of experiments carried out with styrene and benzoyl peroxide at 90° C showed that the rate of the reaction increased with the amount of peroxide used and that under the conditions prevailing in these runs the main part of the reaction takes place between the second and third hour

The ratio of water to monomer is of relatively small importance for the successful performance of a suspension polymerization It is obvious that a larger excess of the aqueous phase will facilitate the reaction, at ratios varying from 10 1 to 4 1 of water to monomer the suspension polymerization can be easily carried out with a variety of stabilizers and under not too stringent reaction conditions However, while the ratio of water to monomer plays no major role in laboratory experiments, it becomes of paramount importance for large scale industrial operations For reasons of economy the maximum amount of monomer should be polymerized in one loading of the reaction kettle and therefore, the quantity of the aqueous dispersion medium, must be kept as low as possible It was found that water monomer ratios of 1 1 can be employed under appropriate conditions of stabilization, agitation, and temperature This is by no means a minimum ratio but in industrial processes a certain safety factor has to be taken into consideration

TABLE III

EFFECT OF SOME ORGANIC AND INORGANIC PEROXIDE ACTIVATORS ON STYRENE PEARL POLYMERS

(Styrene 50 gm · Water 300 gm Talc, 0 8 per cent Temp 90°C)

Activator	Wt on monomer	Time of reaction hr	Result
	%		
Benzoyl Peroxide	2	3	Stable suspension, little polymer formed
Potassium Persulphate	2	3	Polymer globules formed
Sodium Perborate	2	3	Little polymer formed
do *	2	13	Little polymer formed

*added in 3 portions in one hour intervals.

Benzoyl peroxide effectively initiates styrene polymerization in dispersion at temperatures above 50° C [12-14] The polymerization temperature is limited by the softening point of the polymer Approaching it, the globules tend to merge and yield lumpy masses which do not polymerize homogeneously and include some of the suspension stabilizer Therefore, temperatures of about 10° C below the softening range of the reactant materials seem to be most indicated

The pH of the aqueous phase has a definite influence on the ease of pearl' formation Alkaline conditions up to a pH of 8 5 do not interfere with the formation of pearls, reduction of the pH even to 4 0 proves detrimental to the reaction

Keeping the above points in mind it is comparatively easy to control the course of a 'pearl" polymerization and to obtain globular polymers of any desired size

SUSPENSION POLYMERIZATION REACTION

"Pearl" polymerization takes place in 3 definite steps. There is a first period during which the dispersed globules of the monomer remain liquid and show little or no tendency to coalesce as long as stirring is continued During the second step some polymer is formed in the globule and dissolves in the monomer, thus producing gummy and sticky particles which tend to merge with each other Finally polymerization throughout the globule is more or less completed The second (sticky) period is most critical for the outcome of the reaction, since during this period colliding spheres are liable to agglomerate At the beginning of the reaction, while the mass is still fairly fluid, such coalesced spheres are quickly broken up again, and toward the end of the reaction, the globules do not stick together as long as the temperature is kept below the softening point of the product

Whether a particular monomer polymerizes in well defined pearls or whether it lumps together depends upon the stirring, the nature and the amount of the suspension stabilizer, and also on the difference between the density of the aqueous medium and the monomer Best results are obtained by adjusting these three contributing factors carefully to an optimum degree It seems that the finely dispersed stabilizers adhere to the surface of the spheres and form a layer around them, preventing coagulation upon collision during the sticky period of the reaction Superimposed on this phenomenon is the fact that an increased density of the aqueous medium help to prevent localization of the globules in one particular zone of the liquid It is possible to carry out polymerization of monomers, such as styrene, acrylic derivatives, isoprene, etc in aqueous salt solutions of various densities and in mixtures of water and glycols or glycerol

Conclusions as to the mechanism of the suspension polymerization reaction can be based upon 3 experimentally observed facts Firstly, it was found that only those catalysts which are soluble in the monomer are able to efficiently accelerate the rate of the reaction Secondly, the overall rate of monomer consumption was found to be proportional to the square root of the catalyst concentration, while the viscosity average molecular weight was observed to be inversely proportional to the same quantity Both facts point to a radical chain mechanism of the reaction, occurring inside the individual globules A further confirmation of this assumption is given by the calculation of the activation energy of the reaction from its temperature dependency The figure found is approximately 26 000 cal/mol and is fairly close to the one calculated for a bulk polymerization reaction

From such experimental data, the conclusion can be reached that the mechanism of a suspension polymerization is essentially that of a bulk polymerization,[15],[16] which is effectively water cooled Each globule polymerizes separately in true fashion of a bulk polymerization, the catalyst decomposing in the monomer phase and the heat of the reaction being efficiently dissipated by the surrounding aqueous medium.

The Resulting High Polymer

The polymers obtained in both small scale and in industrial operations consist in most cases of rather perfect globules of fairly uniform size Figure 3 gives the size distribution curves of three different batches of polystyrene It is significant that in each of these curves the largest percentages of spheres occur in a relatively narrow size range and the largest globules have diamaters approximately twice that of the smallest Depending upon the nature of the stabilizer and the final percentage conversion of monomer, the globules may be completely water clear, approaching in appearance the best block polymers, they also may exhibit white opacity or all the intermediate degrees of translucency

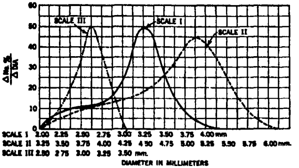


Fig 3 Polymer size Distribution Curves for Suspension of Polymerized Styrene

The "pearls" can be hard, soft, or rubbery, depending upon the monomer or combination of monomers Styrene and acrylic esters yield hard globules which exhibit considerable elasticity and toughness These polymers are soluble in the usual solvents Diene polymers or copolymers containing a diene are often obtained in the form of insoluble spheres which show a distinct swelling action in many liquids For instance, copolymers of styrene and butadiene are rubbery and semi-transparent and apparently consist of globules which are cross-linked to a considerable extent If carried out in bulk such a copolymerization leads to an insoluble and infusible gel which is very difficult to remove from the reaction vessel "Pearls" of this copolymer, however, can be easily removed from the reaction vessel and represent a material which offers no difficulties for rolling or calendering operations

In order to obtain the degree of polymerization of some styrene "pearl" polymers, the viscosity average molecular weight was determined[18-21] Solutions of the polymer ranging from 0 2 0 8 percent were made in toluene and their viscosities measured in the usual way The intrinsic viscosities of the solutions were obtained by extrapolating the sp/c versus concentration graph (Figure 4) and the molecular weights computed from the equation $[\mu]=KM^a$, using for K and a the values of 10^{3} and 0 72 respectively Table IV gives a few examples of molecular weight of polystyrene "pearls" and shows that the molecular weight is of the order of magnitude of 85,000 even under varying reaction conditions However, it can be increased up to about 250,000 if the reaction conditions are adjusted accordingly

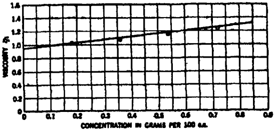


Fig 4 Intrinsic Viscosity *vs* Concentration for Styrene "Pearl Polymers.

TABLE IV

Molecular Weights of Styrene 'Pearl' Polymers

Styrene	Water	% Suspension Stabilizer	% Catalyst	Time hr	Temp C	Mol Wt
50	300	Talc 1	1 0	3	85	85 000
50	500	Bent 3	0 5	15	75	80 000
50	500	Bent 3	1 0	15	75	83 000
50	500	Bent, 3	0 75	19	75	85 000
50	500	Bent. 3	1 0	48	65	93,000

Conclusions

The suspension polymerization and copolymerization of vinyl type or diene type monomers leads to polymers in the form of regularly shaped spheres, the sizes of which can be controlled by the choice of the reaction conditions This polymerization process is employed for the large scale manufacture of polymers, such as polystyrene, polymethyl methacrylate, polyvinyl acetate, etc The experimental as well as the industrial equipment for this process are quite simple and the resulting polymers can be directly used for molding, extruding and similar operations

The "pearl" polymers are as pure as those resulting from a bulk polymerization, however the average molecular weight is higher than in a bulk polymerization, the reaction times are shorter and most important there are no difficulty encountered in the heat control of the suspension polymerization The mechanism of the reaction is essentially that of an effectively cooled bulk polymerization The reaction conditions have to be worked out carefully for each individual monomer and have to be adjusted for specific requirements The mechanical and physical characteristics of the polymers depend on the conditions chosen

BIBLIOGRAPHY

[1] J Abere G Goldfinger H Naidus and H Mark *Ann* N *Y Acad. Sci* *44* 267 1943
[2] H Mark and S Raff High Polymeric Reactions Interscience Publishers New York N Y
[3] G V Schulz A Dinglinger and E Husemann *Z Physik Chem* *B43* 25 47 385 1939 *B50* 305 1941
[5] R G W Norrish and R R Smith *Nature* *150* 336, 1942
[6] W P Hohenstein and H Mark, *J Polym Sci* *1* 127 1946
[7] W P Hohenstein and H Mark, *J Polym Sci* *1* 549 1946
[8] W P Hohenstein F Vingiello and H Mark *India Rubber World* *110* 40 1944
[9] *Brit Pat* 445 742 (1936)
[10] *U S A Pat* 2 108 044 (1938)
[11] *U S A Pat* 2 194 334 (1940)
W P Hohenstein *U S A Pat* Application 1946
[12] C C Price *Ann N Y Acad Sci* *44* 351 1944
[13] R E Burk B G Baldwin and C H Whitacre *Ind Eng Chem* *29* 326 1937
[14] A C Cuthbertson *Can. J Res* *20* 103 1942
[15] H W Melville *Trans Far Soc* *32* 258 1936 *Proc Roy Soc* *A165* 163 511 1937 *A167* 99 1938
[16] J W Breitenbach *Monatsch* *71* 275 1938
[17] G V Schulz and E Huseman *Z Physik Chem* *B34* 187 1936 *B36* 184 1937
[18] T Alfrey Ph D thesis *Polytechnic Institute of Brooklyn*
[19] P J Flory *Ann N Y Acad Sci* *44* 419 1943
[20] A Bartovics and H Mark *J A C S* *65* 1901 1943
[21] A Goldberg W P Hohenstein and H Mark *J Polym Sci* *2* 503 1947

FISHERIES RESOURCES OF WESTERN BENGAL AND THEIR UTILIZATION*

SUNDER LAL HORA

ZOOLOGICAL SURVEY OF INDIA INDIAN MUSEUM CALCUTTA

The *Report on the Marketing of Fish in India* published in 1946 contains data of fish productoin for 1937 38 In that year, the estimated production of sea fish in Bengal was 17 29 lakhs of maunds valued at 34 6 lakhs of rupees The estimated surplus of freshwater fish was then 31 332 lakhs of maunds valued at 432 92 lakhs of rupees The *Report on the Marketing of Fish in the Indian Union* now under preparation gives the estimated production of sea-fish in Western Bengal as 5 772 lakhs of maunds valued at 85 3 lakhs of rupees The estimated marketable surplus of freshwater fish is 11 973 lakhs of maunds valued at 335 7 lakhs of rupees If we leave out of consideration all activities regarding grow more fish during the last decade even then it will be found that 67 2% of the sea fish production and 62 0% of the surplus freshwater fish production of Bengal have gone to the share of East Bengal! Though on the population basis (West Bengal 21,196,453 East Bengal 41 949 710 Census 1941) this division of fisheries seems justifiable it must be remembered that West Bengal is the most industrialized part of the Union of India and contains within its limits the city of Calcutta a problem by itself so far as food requirements are concerned Moreover people of East Bengal eat quite a lot of fresh fish at source which does not come to the market and is not recorded in the above figures

From the figures of fish production and its value given above, the following further facts can be adduced

1 The freshwater fisheries resources were far more valuable in Bengal for they contributed 50 1% of the total production in India West Bengal even now leads the rest of the Provinces and States in the Indian Union with 28 97% of the total freshwater fish production

2 In 1937 38 the average price of sea fish was Rs 2/ per maund and that of freshwater fish Rs 13 8 per maund In 1948 they had arisen to Rs 14 7 and Rs 28/ per maund respectively

3 The high price and production of freshwater fish indicate preference of the people for freshwater fish but during the last decade there has been a marked improvement in the demand for sea fish as the ratios of sea fish and freshwater fish prices in 1937 38 and 1948 (2 14 7 and 13 8 28) would indicate

These important factual data must be borne in mind in considering the fisheries resources of Western Bengal and their utilization As fisheries is a natural resource we may first briefly consider the nature of the country where the resources are located

PHYSICAL BASIS OF THE FISHERIES RESOURCES OF WESTERN BENGAL

Bengal is a deltaic province and is, therefore, a low lying part of India There are in consequence many depressions and marshes in the lower parts and owing to fairly high rainfall they remain filled with water permanently or seasonally In the upper parts, owing to set monsoon seasons, water is stored in ponds for domestic and agricultural purposes so the province is dotted over with innumerable collection of impounded water of varying sizes The rivers of Bengal carry large amount of silt and are, therefore, liable to change their courses very frequently, with the result that innumerable *bheels* are formed in the beds of dead rivers There had been a general tendency for the rivers in Bengal to oscillate from west to east Extensive estuaries are formed by the Ganges and the Brahmaputra, which are almost uninhabited for the greater part of the year There are no suitable harbours on the coast of Bengal and, the silt carried down by the rivers sometimes forms bars at their mouths which render navigation hazardous even during the calm season The bottom is muddy and soft over a greater part of the estuaries and foreshore and the continental shelf round India, particularly round the Bay of Bengal, is very narrow The detritus carried down by the rivers fertilizes the water and the tropical temperature is conducive to fish growth

---

* Talk given at the Discussion Meeting of the Royal Asiatic Society of Bengal on March 10, 1949

As will be clear from the above account the living rivers are now in East Bengal and in consequence the riverine, estuarine and foreshore fisheries are more productive in that Province In West Bengal, the salinity in the estuaries is high and most of the rivers and creeks are strongly embanked in the interest of agricultural crops There is more emphasis on paddy cultivation than fish production in the Sundarban *Abads* The western part of West Bengal comprises dry districts, where large irrigation tanks had been constructed in the past and need for canal irrigation is being strongly felt now The rivers are being dammed for the storage of water for multiple uses

RESOURCES AND THEIR UTILIZATION

We can now examine the fisheries resources of Western Bengal against the background of the preferences of the people, the topography of the country and the basic peasant economy of its inhabitants It will be admitted on all hands that an average Bengali would prefer *RohiMachh* (*Labeo rohita*) to *Bhekti* (*Lates calcarifer*) at any time and for this reason on ceremonial occasions *Rohi* rather than *Bhekti* is in great demand The topography of the country and the present economy of its inhabitants are also more suitable for freshwater fish production and I have no doubt that, if increased fish production is measured in terms of the money spent on various schemes all over India, it will be seen that a comparatively much smaller investment in inland fisheries has yielded very encouraging results Inland fisheries are of various kinds and each type will now be considered separatley

Pond Culture Of all the freshwater fisheries resources of W Bengal, ponds provide a wealth, which is still greatly under developed, inspite of the fact that in starting the Fisheries Department in 1942, the Government of Bengal laid down pond culture as its main objective So far as the scientific side of this development is concerned, Bengal has already been recognized as the leading exponent of this resource utilization Unfortunately, administrative difficulties in harnessing very fully this resource have not yet been overcome A large number of ponds are still lying in a derelict condition Shallow ponds and *bheels*, which could be more profitably used as fisheries, are being reclaimed prematurely for agricultural purposes Water hyacinth is still being permitted to extend into clean fisheries

I am given to understand that the "Rural Pisciculture Scheme started by me in 1944 has been considerably extended According to this scheme, fish-seed was supplied at a subsidized rate to owners of tanks who undertook pond culture on proper scientific basis The operation of the Scheme also made it possible to impart necessary technical information to fish farmers, to demonstrate scientific methods of production, harvesting and utilization of fish crop and to offer the services of a small band of technically trained pond culturists at a nominal charge to pond owners requiring services of skilled personnel

The pond cultural practices of Bengal have succeeded in certain farms in producing 2,000 lbs of fish per annum, a food crop yield of high class protein much greater than can be affected by agricultural practices It is probable, however, that by following Chinese methods, which yield 4,000 to 5,000 lbs/acre/annum, further improvements could be effected There are large areas in which the practices employed do not reach a satisfactory level and in addition there are even large areas in which practically no use is made of the available bodies of impounded water The fullest possible development of these resources is desirable for the long range programme of meeting food requirements and steps to this end are most urgently required in the present state of West Bengal's fish supplies Apart from its role in food production, a programme for development of pond culture is of deep significance in relation to peasant economy, its intimate physical relation to the structure of the village, the lower level of capitalization involved and its dependence on the human element There are three major programmes under pond culture which deserve particular attention in West Bengal and to these I shall now refer

1 PADDY *cum* FISH CULTURE

I have already referred to the embanked condition of the paddy fields in the *Abad* areas of the Sundarbans in the district of 24 Parganas Simultaneously with the paddy crop, a fish crop of 100 to 300 lbs/acre is usually harvested in suitable areas, but the supply from paddy-fields can be augmented several folds through proper cultural methods In China, fish breeding in paddy fields is used for effectively controlling the most serious insect-pest, the stem borer The yields have thus been noticed to have increased by about 10-15% Furthermore, there are clear indications of fish eating mosquito larvæ and thereby preventing the spread of malaria In the Dutch East Indies, fish-culture in paddy-fields has been characterized "as the highest form of pisciculture" and a higher yield of rice to the extent of 5 15% has been reported Small scale experiments conducted by the Directorate of Fisheries Bengal during 1945 46 showed an increased yield of paddy by 150 lbs/acre The FAO Rice Conference at Baguio in March 1948 recommended the adoption of this practice in all suitable areas Unfortunately some critics wanted all fish of 9" to 12", removed from pady fields, to be grown further in ponds Those, who have some idea of the extent of the paddy fields in the Sundarban *Abads*, know this is not practicable in each and every case and who among us will say that a *Rohi* or a *Catla* (*Catla catla*) or a *Mrigal* (*Cirrhina mrigala*) a foot in length is to be despised as food I feel convinced that this extensive resource of West Bengal is capable of great expansion for the increased production of both cereals and fish

2 *Bhasa badha* OR POND CULTURE OF BRACKISH WATER FISHES

Long ago Sir K G Gupta in his reports on the Fisheries of Bengal hinted at the boundless possibilities of increasing fish supply from the estuarine areas by improving and extending the system of *bheris* which, before the Bidhyadhari river became defunct, was found so profitable in the Salt Lakes area in the neighbourhood of Calcutta During my period of service in Bengal a few fisheries of this type were started and some derelict ones were repaired but the terms of the leases of land in most promising places were such that the land could only be used for paddy cultivation but not for fish culture In spite of the best efforts of the Directorate of Fisheries, it was difficult to persuade the District Magistrates to relax the lease clauses and, in the interest of grow more fish to allow the low lying unproductive areas to be used for raising fish crops If such administrative difficulties could be overcome, I have not the least doubt that it will be possible to bring under pisciculture vast areas adjoining rivers and creeks in the Sundarbans There can be no better way of reclaiming low lands in these parts even for agricultural crops than through the operation of the system of *bheris* for fish culture

3 SEWAGE IRRIGATED FISHERIES

The Salt Lakes of Calcutta are no longer used as salt water *bheris* but are now cut up into extensive freshwater fish farms They are shallow and would normally dry up during the hot months but unfortunately the Sewage Outfall Channel of the Calcutta Corporation passes through the Salt Lakes area The greatly diluted Calcutta sewage is taken into a number of fisheries and the results of carp production in them are very profitable If arrangements could be made with the Corporation of Calcutta for a proper distribution of the sewage water to these fisheries, the production in this 70 square miles area will go a long way to meet the requirements of Calcutta during March to June when fish from other sources is normally scarce in the markets. I worked hard and planned the development of this area as a fishery but unfortunately H E Mr. R G Casey, Governor of Bengal who took great interest in the Scheme, left Bengal and since then little attention seems to have been paid to this most productive scheme A public company floated for the reclamation of this area, under the combined auspices of the Government and the Corporation will convert it into a health resort for the over congested town and would produce large quantities of wholesome *pona* (carp) fish The advantage of developing this area is that problems of refrigeration and transport do not arise for with little effort fish can be sold alive in Calcutta even during the hottest months

Before leaving the subject of Pond Culture I wish to emphasize once again that the programme of Pond Culture in Western Bengal and the proper utilization of all our resources in this line will give an immediate relief in meeting fish shortages

Bheel Fisheries Closely allied to pond culture, is the utilization of *bheel* fisheries They have been greatly neglected and overgrown with thick vegetation and now it has become difficult for individuals to reclaim them I admit that methods of reclaiming them are not yet fully understood and therefore experimentation and research are called for We have been considering development of *Bheel* fisheries for at least four or five years but no beginning has so far been made Once the Government can demonstrate a successful method of working *bheel* fisheries I have no doubt private enterprise will not be lacking to utilize this resource for the production of fish

Riverine Fisheries—There are only a few small rivers which in their entirety belong to Western Bengal Proper conservation of fisheries of these must be planned on a scientific basis Some of them are shortly going to have dams and wiers which will have considerable effect on their fisheries The rivers are the main source of fish seed supply and if their fisheries are interfered without making adequate provisions for the breeding of fish, besides deterioration in river fisheries, pond cultural activities will be seriously affected

The rivers which are common to several provinces of the Indian Union and East Bengal can only be developed on a federal or international basis These rivers must be nationalized and suitable fishery conservation measures adopted

Estuarine Fisheries—The only estuarine areas of W Bengal are those located within the Basirhat and Namkhana Ranges of the 24 Parganas Unfortunately, they were not of very great importance in Bengal and I did not survey them properly For the development of these fisheries, refrigeration and quick transport are two most essential requisites and it is gratifying to note that the provincial budget for 1949-50 contains a provision for the supply of power craft to the existing trade for quick transport of fish I have not seen the scheme but presume that equal attention has been paid to the supply of ice for refrigeration purposes.

Fore-shore Fisheries —The chief centres of marine fisheries in W Bengal are the Moore and Fraserganj Islands near the mouth of the Hooghly in the 24 Parganas and the Contai Coast with principle fishing centres at Jalda, Samdraput, Junput and Kalagachia I have not personally studied the fisheries of the Moore and Fraserganj Islands, but if they are comparable in any way to those of the Dubla Island at the mouth of the Passur River, then the following development measures for their fuller utilization could be suggested

1 Arrangement for refrigeration, crushed ice in the first instance, and quick transport of quality fish for the Calcutta market

2 Improvement in the methods of fish processing by the introduction of salt curing, drying on raised platforms, etc

3 Utilization of waste fish and fish wastes in developing by product industries on the spot

As regards marine fisheries of the Contai Coast, I am fairly well familiar with them and would suggest the following phased programme for their development

Phase 1 —Improvement of the existing fishing methods by the supply of fishermen consumer goods towing out boats to the fishing grounds, use of 'Ducks for landing catches , supply of ice in sufficient quantities grading of fish , ensuring utilization of quality fish for table either locally or in the Kharagpur and Calcutta Markets , salt-curing of smaller fish , utilization of fish wastes and waste fish for the manufacture of fish meal or manure and the utilization of shark livers for the manufacture of oil

Phase 2 —Introduction of larger power vessels as tugs and mother vessels, for taking out fishing boa beyond the limits of inshore fisheries, development of fishery Co operatives and provision of up to date marketing facilities for green and dried fish and other fishery products

Phase 3 —Employment of small power fishing vessels in conjuction with mother or factory ships, the latter for the treatment of the produce on the spot, for the safety of the fishermen and for enabling fishermen to stay away from their home for some days

Phase 4 —Deep-sea fishing with drift and seine nets, trolling (not trawling) and long line fishing

I cannot say how long will each phase last, because that will largely depend on the administrative ability of the personnel and the knowledge, earnestness and industry of the technical staff employed Of one thing I am certain in my mind that evolutionary changes, as represented in the above phased programme, will have far more chances of success in the background of the economy of the operatives and the preferences of the people than any revolutionary innovations Short circuiting of the evolutionary programme may be possible within limits but any marked deviation may result in serious failures

FISH SUPPLY PROBLEMS

The fisheries resources of Weste n Bengal, though perhaps inadequate for the needs of its people, are fairly varied and extensive and are capable of great expansion through well planned economic development schemes At the very outset, it must be borne in mind that the fish supply problems of West Bengal are two fold Calcutta and the neighbouring industrial areas with high purchasing power and rural Bengal with peasant economy and very low purchasing power We shall not be serving Bengal faithfully unless we bear in mind both the problems simultaneously I am, however, aware that the solution of the Calcutta problem may solve to some extent the problem of supply to rural Bengal as a sequence thereof

Calcutta and the industrial centres in its neighbourhood are cosmopolitan in regard to the composition of their population and generally speaking their inhabitants are less conservative more literate and hold progressive ideas Through a well organized marketing propaganda many innovations can be introduced in these areas On the other hand, the rural population is very conservative, particularly in the matter of food, less literate and backward so far as modern developments are concerned, The utilization of fishery resources must be planned against this background

Leaving alone for the time being the heavy fish imports from East Bengal and the neighbouring provinces of the Indian Union, the fish supply position of Calcutta can be improved by the utilization of the Salt Lakes fisheries, *bhasa badha* and paddy field fisheries of the Sunderbans, development of estuarine and foreshore fisheries and the utilization of the *Bheels* Pending these local developments, which may take some time, Calcutta should import fish in ice or refrigerated holds from the West Coast by arrangements with the Governments of Travancore Cochin and Madras All quality fish production along the West Coast, after meeting local requirements, should be brought to Calcutta I was greatly surprised that in the Hong Kong markets, the cheapest fish was the Canadian Herring or *Hilsa* If currency restrictions can be overcome, I would certainly like to see Calcutta markets flooded with Canadian *Hilsa* Now Calcutta and other industrial centres are feeding on the rural areas where the supply is already inadequate with the result that, in the absence of any other high quality body building and protective food, ill health and misery are the lot of the rural population

So far as the rural areas are concerned, the proper development of inland fisheries, particularly pond culture, holds the most brilliant prospects Providence made Bengal a country full of tanks, ponds and *bheels* and made its people like pond fish in preference to other varieties It should, therefore, be the duty of the administrators and servants of the country to fully utilize the local resources and to cater to the preferences of the people

Bottle Neck in the Utilization of Resources

During my period of office in Bengal, four departments, besides the Directorate of Fisheries, were looking after the various aspects of the Provincial fisheries, namely (i) Revenue Department, which provided funds for the rehabilitation of fishermen and improvement of tanks, looked after the management of *Khas Mahil* fisheries and settled legal aspects of the utilisation of land (paddy cultivation or fish culture) etc , (ii) Industries Department helped in the procurement and distribution of fishermen consumer goods, (iii) Co operative Department, worked among fishermen to organize them into effective units for production and marketing of fish and distribution of consumer goods and (iv) Irrigation Department, that owned a large number of canal and *bheel* fisheries, looked after the sale of fisheries rights in the waterways of the province Though for fish supplies the Directorate of Fisheries was always held responsible for all acts of omission and commission, the position behind the scenes was lack of proper perspective and co-ordination between the various Departments of the same Government, with the result that much energy was dissipated in commonplace bickerings and very little came out of the pooled resources of all these departments While attending Departmental Committees and Conferences, I was always reminded of the dictum of the late Dr N Annandale He was of the opinion that the wisdom of a Committee is less than that of its least intelligent member We all know by now that compromises have never paved the way to any big success but only help to postpone decisions on matters of vital importance I do sincerely hope that, with the advent of peoples' Government, these are things of the past, though I have my apprehensions because prejudices and jealousies take a long time for their eradication The first bottle neck for the proper utilization of fishery resources is, therefore, lack of co ordination and so long as officials do not give up "Departmental views" and learn to face the problems as a whole, much progress cannot be made

For any development plan, there are three essential requisites, i e , Men, Material and Money These essentials are arranged in order of priority Are there suitably qualified men available in the province for taking charge of development plans? So far as I am aware, they are very few It is obvious, therefore, that training of personnel is priority No 1 in our plans of fisheries development I must make it clear here that for developing natural resources, outside experts can be of little value and that experience of persons with knowledge of local conditions is most essential Unless we have practical men on the scene the question of material required for our development plans does not arise, as investments made in materials in the absence of knowledgable persons to use them can be written off straight away The question of money, to which highest priority is paid at present, is of very minor importance When you have practical men who know precisely what equipment is required, the results are bound to be encouraging right from the beginning and the public will then not hesitate to invest in fisheries development Most of the major schemes would be taken up as Public Liability Concerns, partly with Government funds and partly with public funds Taking everything into consideration, the second bottle neck is the lack of trained and experienced personnel

In my opinion, a lasting and nation wide development of fisheries in Western Bengal must be a slow and gradual process of the evolutionary type, in which training and experience of the personnel actually engaged in research and development will be our greatest assets Any hurried, spectacular measures, such as trawling experiment of the 'Golden Crown" or training of students in American Shad Fisheries and Central European Carp Culture Industry, are bound to fail as they had already failed not in the very distant past Large schemes designed to bring the produce of the seas into Indian markets and to habituate the people to eat unfamiliar fishes will take years to complete From the short term point of view, it is necessary to carry out a large number of smaller, less ambitious, but economically sound projects which will in the aggregate increase production considerably It is extremely unfortunate that while big schemes are being readily financed adequate money for smaller, but highly productive schemes, is usually not forthcoming This mental outlook with regard to the financing of schemes is the third bottle neck to be tackled

Conclusion

In conclusion, may I quote the concluding paragraph of Sir P M Kharegthat's communication to the *Times of India Bombay*, dated 14 2 49 on "Failure of Food Drive ' wherein he stated

> In short agricultural production can only be increased if a number of different measures are adopted with energy and the necessary requisites for carrying them out are made available by Government of India There is no magic wand that can be waved for increasing output It will not be achieved merely by talking and planning It will entail hard and laborious work by the agriculturists and by those who have to guide them It will require a large expenditure of money and materials It will need a far sighted policy by Government giving security to the producer to ensure his whole hearted co operation and joint working by all the departments of the Government concerned Food production has not increased because these requisites have not been available It is now up to Government to make them available Will they do so?"

The same applies *pari passu* to fisheries production in Western Bengal Our valuable resources, in spite of talking and planning for years, still wait utilization to feed the common man so as to raise his nutritional standard and to make him healthy and strong

EARLY HISTORY OF THE BOTANIC GARDEN, BANGALORE

M H MARI GOWDA
ARNOLD ARBORETUM JAMAICA PLAIN MASS U S A

THE Government Botanic Garden of Mysore is situated in Bangalore It is popularly called *Lal-Bagh* (Red Garden) This name was originally given to the garden, about 200 years ago, by Haidar Ali due to its profusion of red roses and other red flowers The early history of this garden is somewhat obscure and fragmentary During the past few months, the writer made some studies on this subject, and the information obtained appears to be both valuable and interesting It is proposed here to present an account of the early history of this garden from its beginning up to the end of the nineteenth century

The city of Bangalore was established by the efforts of one Kempe Gowda as early as 1537 He built a mud fort and, at some distances from it, four watch towers (*Mantaps*) were erected in four cardinal directions[1] The eastern tower is now situated within the present compound of the garden

Haidar Ali, originally a Pathan soldier in the Mysore Army, came to power by gradual stages about the year 1760 and usurped the throne of Mysore It is stated that he selected a spot (later developed into the present garden) east of the fort for the purpose of an orchard and royal garden[2] By that time there were already one or two royal gardens in existence in the State, *e g*, (*a*) ***Khan Bagh*** at Sira, established during the time of Dilwarkhan, the Moghul Emperor s representative in the South, and (*b*) ***Bidanore garden***, often referred to as ‘ a garden equal to the gardens of Paradise —the pleasure garden of the Hindu Rani of Bidanore Haidar Ali, having Moghul tastes, planned *Lal Bagh* principally on the model of the garden at Sira He imported plants from Delhi Lahore and Multan Separate plots were set apart for different kinds of fruit plants like pomegranates and figs, and others for flowers [3]

Tippu Sultan, the son of Haidar Ali improved the garden Two old mango trees, said to have been planted during his regime can be seen in the garden He maintained a regular garden establishment The head man in charge of the garden was called ‘ *Daroga* Two ‘ *Darogas*" (father and son) were in charge of the garden successively Incidentally the designation *Daroga*" is still in use in the palace garden establishment of His Highness the Maharaja of Mysore

A small tank on the southern end of the garden was originally the main source of water supply Water was conveyed to the garden from this tank along an open ditch Three additional wells were dug during the time of Tippu Sultan, and water was lifted in big leather drums with the help of bullocks (*Kapille*)[4] This water also was used for irrigation

After the end of Tippu Sultan s reign in 1799 the garden passed into the management of a retired Englishman, named Major Waugh, and remained as his private property till 1819 He showed great zeal in the improvement of the garden and in the introduction of exotic plants In the same year, he made a gift of the garden to the Marquis of Hastings, at that time Governor General of British India in Calcutta Most probably the matter was referred to Dr Nathaniel Wallich (the then Superintendent of the Bengal Presidency Botanic Garden) who by way of recommending the acceptance of this garden as a branch of Bengal Presidency Botanic Garden wrote

> The garden in question at Bangalore has been for a considerable time known to me from my correspondents both at that and other stations to the South of Ganjam as affording a striking instance of the practicability of bringing the fruits of Europe to complete perfection in this country under a happy combination of favourable localities of soil and climate when aided by such efforts of zeal skill and indefatigable perseverance as those which have distinguished the useful labours of Major Waugh Some recent communications of seeds from thence have further tended to corroborate me in the conviction that the climate of Mysore is eminently suited to purposes of horticulture and for that reason might with the fairest prospects of ultimate success be made subservient to a very great desideratum in this east of the world that of an intermediate nursery or depot for the introduction and acclimatising of the fruit trees of England

The garden was accepted by the Governor General, who communicated to the Madras Government the following ‘ that Major Waugh s garden might in connection with the Honourable Company s Botanical Garden established in this Presidency be rendered of great public advantage as an intermediate nursery for introducing and acclimatising in India, the trees and plants of Europe and China [5] The garden thus became a property of the East India Company and remained so, as a branch of the Bengal Presidency Botanic Garden till 1831 In that year it was handed over to the management of the Chief Commissioner of Mysore and remained under his general supervision till 1839 For a short period of about three years (1839 42), the garden was in the hands of the newly formed Agri Horticultural Society of Mysore, but unfortunately this body did not continue beyond 1842, and the supervision reverted to the Chief Commissioner

For the next fourteen years (1842–1856) the garden passed through its darkest period No improvement of any sort was made during this time and the garden was somehow kept accessible to the public by the occasional cutting down of weeds and grasses by convict labour which was employed to give the paths an occasional sweeping

In the year 1856, Dr Cleghorn* along with one Mr Jeffrey, then Superintendent of the Madras Agri-Horticultural Society's Garden, conferred with Sir Mark Cubbon, about establishing a *botanic garden* in the State The Chief Commissioner, who was interested in the development of horticulture in the State, welcomed the idea *Lal Bagh* was selected as the garden best suited for such purpose [6] It was thus made the Government Botanic Garden and entirely a Government establishment in August 1856 **

Immediate action was taken to set the garden right Dr Cleghorn wrote a letter of request to Sir William Hooker, Director of the Royal Botanic Gardens, Kew, to select a superintendent for the garden Pending the arrival of a superintendent a *maistry* (head gardener), by name Heera Lal, was appointed on Rs 25/ per month and placed in the garden to carry out certain work under the instruction of Dr Cleghorn A committee, consisting of the secretary to the chief commissioner the superintendent of Bangalore division and Dr Kirkpatrick, was set up to take measures to preserve all the more interesting botanic specimens and to make the grounds attractive In two years a great deal of work was done, the drives were broadened and gravelled, a dwelling cottage and office for the superintendent was constructed in the garden and the garden compound wall was erected

On Sir William Hooker's recommendation Mr William New was appointed as the first superintendent of the garden and he assumed the charge on 10th April, 1858 In his letters to Kew, he wrote there is no one who takes any great share in the management of the garden in Dr Cleghorn's absence, but when anything is wanted, it is obtained by applying to Capt Cunningham General Cubbon's Secretary, Dr Kirkpatrick looks over the accounts, and any new road or walk is executed under the superintendence of Capt Puckles of the public works department at present there are employed for watering cleaning, and garden work 16 men, with a *maistry* as he is called, over them

Now began the organised introduction of plants into the botanic garden and maintained exchange of plants with other institutes in India and abroad In the summary of his report for 1858 59, he has given an account of fruit plants (apples, pears etc) received from the garden of Ootacamund, and seeds and plants from Sir William Hooker, along with other details of improvements such as the addition of three more wells, the brick lining of the open ditch, the formation of a walk on the tank bund, the grafting of fruit trees and other works done in the garden [8] Dr Cleghorn in his Memorandum on the Government Garden of Ootacamund, on the 6th August 1857, wrote "A complete set of fruit trees is about to be supplied to the Bangalore Garden, from which, by reason of its central position and cheaper carriage, I expect there will be a most abundant distribution of valuable productions radiating over the country [9] A few of the Australian *Eucalypti*, planted by New, just behind the tank *bund* and the drive, are still growing well in the garden These trees are approximately ninety years old

During New's superintendentship a library of horticultural books was started and on the suggestion of Dr Cleghorn, he prepared for the first time a complete list of plants found in the garden The list was communicated to the Botanic Society of Edinburgh in the year 1861 It was published in 1861[10] and republished in 1863 [11]

On the expiry of the term of New, Mr A A Black, from Kew, succeeded him, in January 1864 Black gave an account of various plants received from Dr Cleghorn, Dr Kirkpatrick, and Capt Puckle in his report 1864 [12] From 1864 to 1874, I am unable to find any further record or information, little improvement worth recording was undertaken during this period

J Cameron took charge of the garden in the year 1874 The official supervision of the garden remained under the Chief Commissioner till 1881, after which the management came under the Government of His Highness Chamaraja Wodeyer, the Maharaja of Mysore He gave a reception to the late King George V in the garden and he laid the foundation for the 'Albert Victor Conservatory on November 28th, 1889

Under the State Government the area of the garden was increased From the original area of about forty five acres at which it remained till 1881, the garden area was more than doubled at the close of the century In the year 1889 thirty acres of new ground, on the eastern side, were added to the garden In the year 1892, thirteen acres, including the watch tower (*Mantap* rock), were added The rock commands a fine view of the garden and the city, being one of the highest points in Bangalore In the year 1894, some more land (about 9½ acres) round the *mantap* rock was acquired, and thus, the area became approximately one hundred acres at the close of the nineteenth century In the year 1891, a new iron gate (now the main gate) was erected

Cameron could be regarded as the life and soul of the Government Botanic Garden at Bangalore from 1874 to 1908 The services he rendered to horticulture in Mysore are too numerous to be listed here. His name is particularly associated with the introduction of useful plants not only to the garden, but also to the State His letters to Kew are interesting

---

*Dr Cleghorn was the Chief Conservator of forests in Madras Presidency and Superintendent of Botanic Garden in South India. He was appointed in 1855 to the office of botanical advisor to the Government of Mysore under the Chief Commissioner

**Unfortunately the year of origin of this garden is quoted by mistake, as 1874 in the *Brooklyn Botanic Garden Record*, 27 259, (1938). Evidently the information received by them from India on this point was wrong and valuable and reveal his zeal for enriching the collection of plants of economic value to the State He collected a large number of drawings, and local names of hundreds of plants He retired in 1908, leaving behind him many valuable records *

---

*In the preparation of the above note I received considerable help from Dr D Chatterjee of the Indian Agricultural Research Institute New Delhi and Mr H S Marshall of the Royal Botanic Gardens, Kew, to whom I wished to record my deep gratitude

REFERENCES

[1] Rao, C H *Mysore Gazetteer 5* 93, 1930
[2] Rao, C H *loc cit* 101 1930
[3] Rao, M S Modern Mysore, 121 280, 533, 1936
[4,5] Annual Repost on Government Gardens and Parks in Mysore for 1904 05 Pp 1 & 2
[6] Cleghorn H Forests and Gardens of South India, 330 34 1861
[7] Manuscript No 703 of Indian letters 1844 1900 in the Kew Library
[8, 9, 10] Cleghorn H *l c* 336, 344, 361
[11] *Trans Edin Bot Soc 1*, 223 1863
[12] Report on the Mysore Government Garden, Bangalore for 1863 64

PHYSICAL GEOLOGY AND FOREST DISTRIBUTION*

G S PURI

FOREST RESEARCH INSTITUTE, DEHRA DUN

IN his studies on the distribution of forest vegetation in relation to main geological features in the Nainital district, U P, Smythies (1919, p 242) concluded that 'the geology of the tract is a *predominant factor in the distribution of forest types* ' While accepting this thesis to be applicable only in Europe and not in India, Champion (1920, p 154) stated that in India "a vast amount still remains to be done in this very interesting line of investigation, and that we will hope that when we have our own ecologist he will be able to give us further information "

These publications have just come to my notice and I take this opportunity to record my observations in support of Smythies conclusions and draw attention to the fundamental relation between plants and geology

The underlying rock governs the growth and distribution of vegetation at the surface in two ways (1) by presence or absence of mineral elements and (2) by structural variations in the body of the rock, *viz* dip *versus* scarp slope

(1) The effect of underlying lithology on distribution of forest communities has long been appreciated both in this country and in Europe The earliest known work in this country is by a distinguished geologist, Mr C S Middlemiss (1890), who has shown the relation between geology and forest distribution Middlemiss' observations are in close agreement with that of Smythies and my own observations in the Dun valley (1949f)

> Middlemiss states that 'the following generalizations seem to hold to a certain extent ; though numberless modifications, dependant on those natural and more superficial causes which I need not stop to mention have great prominence
>
> (1) "The northern limit of the Tertiary zone is practically the limit of the *sal* tree, and therefore of the reserved forests of this region This geological boundary is a very important and marked one, and seems to have a real and direct effect on the prevailing forest species"
>
> (2) The middle Siwalik sand rock generally forms low undulating country, and towards the plains supports a miscellaneous jungle
>
> (3) Wherever the dip of the strata is low, 10° to 30°, and down hill (which generally coincides with a northern aspect), the *sal* tree has flourished far above any other tree
>
> (4) All escarpments and sloping country, with dips towards the hill support a miscellaneous jungle
>
> (5) All surface gravels, dry river beds and single islands which are constantly liable to change to being washed away and re made lower down, only support the *Khair*, the *sissoo* or *shisham* and sometimes bamboos (pp 13 14)

The distribution of different types of forests that I have recently studied in the Dun valley at Lachiwala, Thano, Maidan, Kansrao and Asarori fits in favourably with the scheme suggested by Middlemiss and Smythies' observations in the District of Nainital and extend the applicability of this relationship to other areas

Troup (1916) found that in the Western Himalayas Chir pine communities are mostly confined to quartzite rocks and the blue pine occurs on mica schists My observations (Puri, 1949e) in the Parbatti valley Kulu agree with those of Troup (1916, 1921) and these two pines are found closely associated with these two types of rock

Although, chir pine occupies a lower elevational zone than the blue pine, I found innumerable instances in Kulu where it occurred at higher altitudes than the blue pine and Deodar Troup (*loc cit*) has given similar examples of chir pine occurring on quartzite above the zone of the blue pine in the Tirthan valley, Kulu

Deodar occurs mostly on phyllites and shales and on flood plain deposits of a clayey nature, both in the Beas and Parbatti valleys The absence of the chir pine from the Beas valley where the chief rock is mica schist shows clearly the dependance of this species in the Western Himalayas on quartzite formations Similarly, chir pine is characteristic of quartzite rocks in Chakrata forests (Troup, *loc cit*) In addition to quartzite formations the chir pine occurs abundantly on Siwalik sandstones and conglomerates and as it will be shown below these rocks resemble quartzite in having low amounts of calcium

---

* Published with the permission of the President, F R I, Dehra Dun.

In my paper on the conifer forests of the Kulu Himalayas to be published shortly I have described in detail many examples showing intimate relationship between rock type and forest type To anticipate these results silver fir forests are chiefly confined in these valleys to glacial moraines at high altitudes usually above 9500 ft but in the Kashmir valley pure fir forests have been found at as low elevations as 6 000 ft on moraines (Sher Singh 1948) The blue pine ascends from 4000 ft to upper limit of tree vegetation on flood plain deposits of a sandy nature and on scarp slopes of mica schists thus occurring above the elevational zone of the so called high level species Evidence has also been presented to show in the same paper that the distribution of such conifers in the Western Himalayas is not governed by altitude alone as it is commonly believed but the fundamental effect of the underlying rock on their distribution has been masked by the effects of large altitudinal differences that are met with in this region These observations are in agreement with the following remarks of Smythies (*loc cit* p 240) In these older rocks, there are huge differences of altitude so that the effects of differences of height to a great extent mask the effects of rock types

The intimate dependence of forest type on rock type in Europe is reflected in such names as Beech forests of Chalk Health pine country of Sands and Sandstones, Oak forests of the Weald clay Ash woods of Limestone, and Limestone scrub (see Tansley 1911) My studies (Puri 1949a 1949b) on the vegetation of the London basin and in mountainous country North of England have clearly shown that forest vegetation in all phases of its existence *viz*, colonising, developmental and successional is intimately related to the surface geology of the country In the *sal* forests of the Dun valley the occurrence of a similar relationship between the vegetation and rock types has already been pointed out A similar relationship in the Hoshiarpur Siwaliks shown by me (Puri, 1949d) may also be mentioned

The examples given here are by no means all that can be given in support of Smythies thesis but they are typical illustrations to show that lithology of the underlying rock has one of the most powerful effects on the growth and distribution of forest vegetation It may be stated here that in emphasizing this relationship between vegetation and rocks the effect of other factors, *e g* climatic biotic or historical is not lost sight of As a matter of fact, vegetation is the cumulative result of all the ecological factors, of which geological, is perhaps of the greatest importance It is the aim of this note to show that geological factor is the master factor and its study is of the vital importance for silvicultural research

Of all the mineral elements present in rocks Calcium is, perhaps, of great importance for plant growth, since nearly 20 50% of the mineral matter mobilized by trees is Calcium oxide Other bases are also important but the influence of Calcium is known to outweigh that of all other bases combined It, therefore seems that the relation between plant and rock is fundamentally the relation between Calcium content of the rock and Calcium requirements of the plant

To explain this point further it is necessary to examine the Calcium content of various rock types and plants growing on them In the Kulu Himalayas quartzite rock has nil to low percentage of Calcium oxide while 5 10% is present in mica schists and the amount of Cao is still greater in phyllites The percentage of Cao in leaf samples of a few plant species growing on these rock types is given below

	Species	Percentage of Cao in fresh leaves on dry basis*
1	*Pinus longifolia*	0 560
2	*Pinus excelsa*	0 982
3	*Cedrus deodara*	1 208
4	*Quercus semecarpifolia*	1 579
5	*Abies webbiana*	1 596
6	*Quercus dilatata*	1 659
7	*Quercus incana*	2 004
8	*Picea smithiana*	2 240

---

*Average of two determinations which have been kindly made by Mr A C Gupta, my research assistant

It will be seen that the chir pine community with the minimum requirements of Cao occurs abundantly (in colonizing stages) only on quartzite formations, while communities with greater requirements occupy schists and phyllites Both during colonization as well as development vegetation is influenced by Calcium in the rock and the amount of Cao in rocks basically determines the type of plants that will grow on them

The availability of minerals for plant growth, tends to vary in a single bed in accordance with position on dip and scarp respectively (fig 1) Mineral water will seep through the strata in the direction of the dip and scarp slope will thus become greatly leached The dip slope, on the other hand, will remain

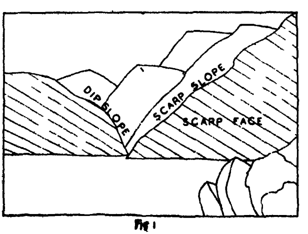


Fig 1

enriched by continually receiving seepage waters from other areas Thus, in strike valleys the two sides will always have different amounts of available bases and will consequently bear different types of vegetation An example of such a valley is shown in fig 2 The

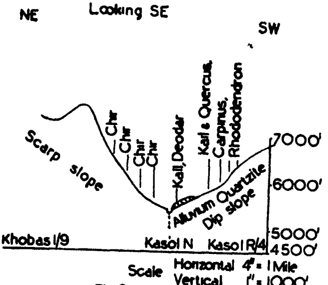


Fig. 2

scarp slope of quartzite in Kasol valley is either bare of tree vegetation or bears scattered trees of *Pinus longifolia* On the dip slope there occurs the blue pine community with *Quercus incana, Rhododendron arboreum* and *Carpinus* sp, trees of *Cedrus deodara* are present on alluvium that is overlying the solid work

The Long Sleddale valley in the English Lake District (Puri, 1949b) is another example of a strike valley where the vegetation on the two sides is related to differences in nature of the slope Dip slope of the slaty rock is occupied by ash oak hazel community, while oak or oak-birch community occurs on the scarp slope

The author has found similar relationship in numerous valleys at Box Hill where on scarp slope of the chalk yew beech and ash box communities were found and the dip slopes were occupied by oak birch beech communities (Puri, 1949a)

In valleys which are carved in or against the direction of the dip of the strata mineral conditions as well as vegetation types on both sides will be similar as is shown in fig 3 The two sides in the Parbatti valley between Jari and Kasol are scarp faces of the quartzite formation and, therefore, bear non exacting community of the chir pine Local variations that may occur due to the presence of surface deposits on the rock need not hide the true relationship sketched above

The two sides in the Parbatti valley are not geological scarp but for purposes of mineral relations and plant growth their properties are similar to true scarps Similarly there occur in Nature dip faces on scarp slope and in favourable locality factors thus created species or communities characteristic of dip slope may be found in small patches on the scarp slope To an Ecologist, therefore, the name "physiological scarp" or 'physiological dip" may, perhaps, be more appropriate for such cases As far as their growth is concerned plants do not follow strictly geological scarp or dip but they occur in certain physio ecological conditions that are provided by such localities Examples of "physiological dip" were seen in the Grahan valley

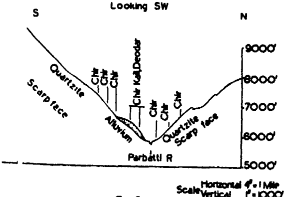


Fig. 3

In addition to distribution the succession of vegetation is also governed by structural variations in the body of the rock For example the chir pine community on the scarp slope of quartzite will remain in a seral stage, while on the dip slope it quickly progresses to Kail or pine oak community Depending upon the amount of available minerals in rocks and climatic conditions scarp slopes usually bear pioneer communities which tend to remain in seral stages, while on dip slopes plant communities generally progress to climax types This relation has been found everywhere in the Kulu Himalayas but further data is required from other areas to generalise it

Similar relationship between forest communities and structural geology has been shown to exist in Europe (Puri, *loc cit*) and it may be pertinent to conclude that lithology and structural features of the underlying rock are the predominant factors governing the distribution, development and succession of forest communities

The importance of this fundamental relationship between forest communities and rock is obvious for successful forestry and silviculture On scarp slopes of quartzite formations which bear only seral community of the chir pine, it will merely be waste of time and energy attempting the planting of Kail or Deodar On the other hand, planting of these species in chir community on dip slope will be beneficial and result in accelerating the progress of succession to climax Deodar forests Smythies (*loc cit*) examples regarding planting of various species on rocks most suited to them could be multiplied to any extent, but this should be sufficient to show that this knowledge is of great use in planned scientific forestry

Thus, it may be concluded that for successful silviculture (Puri, 1948, 1949c), or land conservation (Puri, 1949d) the fundamental relationship between forest communities and rocks is of vital importance

REFERENCES

Champion, H G "Geology and forest distribution , *Ind For*, *46*, 1920

Middlemiss, C S Physical geology of the Sub Himalaya of Garhwal and Kumaon' *Mem Geol Surv Ind 24* 1890

Puri G S ' The secular or prehistorical factor and its application to forest ecology and silviculture , *Ind For Ranger College Magazine* 1948

Puri, G S Surface geology, vegetation and plant succession in the London Basin", *Proc Ind Sci. Cong Allahabad*, 1949a , The ash-oak woods of the English Lake District", *Jour Ind Bot Soc*, *28* 1949b , 'The historical factor and its application to Forest Ecology, *Ibid*, 1949c ; ' The ecology of erosion and landslips ', *Journ Ind Geogr Soc* 1949d The Conifers of the Kulu Himalayas ', *Unpublished* ,1949e , 'The vegetation of the Dehra Dun valley with particular reference to the regeneration of *sal* forest ', *Unpublished* , 1949f

Sher Singh, Regeneration of fir forests of Pir Panjal, Kashmir" *Ind For*, *74*, 1948

Smythies F A Geology and forest distribution ', *Ind For 45*, 1919

Tansley A G Types of British vegetation , London 1911

Troup, R S *Pinus longifolia*, Roxb —a sylvicultural study", *Ind For Mem*, *1*, 1916 The silviculture of Indian trees, Vol 1 , *Oxford*, 1921

DEVELOPMENT OF INTERNAL COMBUSTION ENGINES IN INDIA

P SRINIVASAN

INDIAN INSTITUTE OF SCIENCE, BANGALORE

A number of plans have been drawn up for the economic development of our country All these plans provide for improved agriculture, better irrigation greater road and rail mileage, higher shipping tonnage, and a bigger expansion of aviation Emphasis has been laid on the development of power from river valley projects, on ameliorative measures involving huge programmes of civil construction, and, in general, for rapid industrialization

A glance at the chart in the appendix will show that internal combustion engines find applications in all the above endeavours For instance, when the planners envisage doubling the road mileage the number of automobiles on road will more than double itself Conversely, when more automobiles are produced which means more auto engines, a greater road mileage will be required In this way most economic activities are interdependent, and a development in one field will necessarily mean a parallel development in the allied field

With the industrialization of the country there will be an increase in the volume of production resulting in a large movement of raw materials and fihished goods This will have to be met with by adequate provision for road transport services The truck being the ideal vehicle for short distance transport, a greater number of them will have to go on the road

Though the railways have been supposed to be highly developed the route mileage is not at all comensurate with the size of the country, and the position of locomotives is far from satisfactory In the expansion and improvement of railways the prospects of Diesel traction which has made rapid strides in the U S A and the Continent must be explored, more particularly, where long distances have to be traversed and where water and coal are scarce.

In the matter of maritime activities our country possesses only a small fraction of the world shipping tonnage The need to develop the smaller classes of shipping for coastal and inland waterways is urgent In this class of shipping the I C engine has become supreme having completely ousted the steam engine from competition

Civil aviation which is making phenomenal progress needs engines in large numbers to fly more passengers and carry greater freight every year

The I C engine has made inroads even to non-transport endeavours and in recent years has completely revolutionized agriculture, the biggest of industries in the United States, Russia, and the United Kingdom America, the pioneer in the application of the gasolene power to the farm, is to day in a position to dictate food policies all the world over The need to apply I.C. power to agriculture arises out of the imperative necessity to improve food production in order to stop the subsidy on imports which is mounting to astronomical figures

The colossal schemes of power development from river valley projects depend on the construction of high dams The flow of prosperity from cities to villages depends on a net work of national high ways The contentment of workers in industries depends on launching huge schemes of labour housing Thus the amount of civil construction jobs to be taken on hand is really enormous If the results are to be quick and efficient the part the I C engines will have to play in these giant schemes will be undoubtedly vital Hence the necessity to improve the index which is relatively very low, namely the I C horse power developed per capita

In any scheme of developing internal combustion power in India certain special features of the industry have to be kept in view The I C engine, as seen in Table I, is an assemblage of main components accessories, and standard parts The engine builder or assembler, as he may be more appropriately called manufactures only the main components and depends on sub-contractors for accessories and standard parts Each one of the items listed under the sub contractors has in recent times assumed the dignity of a separate industry The Table shows clearly to what extent sub contracting is carried on in engine manufacture but they have this in common, they have not just talked about what should be done they have cooperated and done it

Cooperation or team work in industry is nowhere better exemplified than in the case of I C engine manufacture Consider an engine builder say Pratt & Whitney who are sub contractors to a firm of aircraft builders But Pratt & Whitneys depend upon Bendix Stromberg Bosch Scintilla, Eclipse Lodge and other proprietery firms to mention only a few for the supply of carburetters generators magnetos starters and spark plugs

TABLE I

I C ENGINE BREAK DOWN

System	Main Engine Component	Accessories or Proprietory Parts	Standard Parts
Induction System	Manifolds Super Chargers	Air Cleaners	
Fuel System		Injectors & Injection Pump Petrol Pump Fuel Filters Carburetters, Piping Cocks Small Valves Fuel Tanks Fuel Gauges	Bolts Clips Counter Weights Dowels Ferrules Flanges Gaskets Gears Keys Liners Lockwire Nuts Rivets Spacers Screws Sleeves Shims Springs Studs Washers pins
Ignition System		Magnetos Sparking Plugs Coils Distributors Generators Batteries Switches Cables	
Exhaust System	Manifolds Silencers	Piping	
Principal Components	Cylinder Blocks Cylinder Heads Cylinder Barrels Cylinder Hold Down Bolts Crankcase Crankshaft Camshaft Connecting Rod Connecting Rod Bolt Timing Gear Fly Wheel Prop Reduction Gear Balance Masses Dynamic Balancers Rocker Arms Valves Valve Springs Valve Seating	Pistons Piston Pin Piston Ring Ball and Roller Bearings Split and Bush Bearings Cylinder liner	
Lubrication System		Relief Valves Oil Pumps Oil Cleaners Oil Piping Oil Coolers	
Cooling System		Fans Fan Belt Water Pumps Radiators Rubber Hose Connection Hose Clips Thermostats Dash Heat Indicators	
Power & Speed Control	Engine Controls	Governors Instruments	
Starting System	Hand Starters	Starting Motors.	

If any one link in this chain of industries is considered its existence is found to be associated with several broad fields of activity design, manufacture inspection supply of accessories, testing, development, sales installation, operation maintenance, and last but not the least the training of personnel 'As in other fields of endeavour the result is the outcome of team work by individuals, differing widely in education and ability,

So the I C engine is essentially a product evolved out of co-operation of many firms and team work among many men The one drawback often pointed out in our industrial structure is a lack of this spirit of work ing together There will be no co-operation between man and man in a department, no co-ordination between one department and another and absolutely no connection between one institution and another This state of affairs calls for immediate rectification The American prosperity is largely attributed to the way in which men have learnt to put their heads and hands together in a joint endeavour to surmount a difficulty or solve a problem

The complexity of modern industrial machine, where firms of different standing and men of different abilities co operate together in the making of a product has necessitated the post of a co ordinator–one who always interprets what has been done and organise the activities of various bodies The co-ordinator must consider the manufacturing process and select the most suitable material, he must see that inspection is vigorous enough to justify the stress that is allowed in the component part, he must know what parts are available from outside firms and how best he could subcontract them, he must concern himself with the testing and development of the engine, think of installation, maintenance, and operation and keep abreast of developments elsewhere In all the tasks he requires competent staff and proper inspection and testing facilities

Another aspect which needs special mention in connection with industry is the minute attention to details that is called for at every stage of manufacture A little oversight in arranging the fuel pipe from the petrol tank to the carburetter, for example, may cost the life of many men by the engine failing due to vapour lock somewhere in the pipe as shown in the diagram Every part in an engine needs special care and nothing goes by default

Co-operation, co-ordination and attention to details, the three important components of an engineer have to be developed in a large measure if the industry has to be built up efficiently

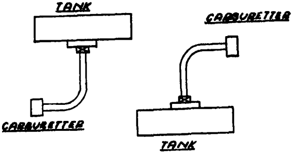


Fig 1 Possibility of vapour lock is more on the R H S. arrangement than on the L H S

The present tendency is to regard the concentration of anything at a particular place as necessarily harmful The system of sub contracting decentralizes industry, makes possible an even distribution of population, relieves acute congestion in cities and with attendant benefits is a great advantage in terms of defence Modern industry has become so specialized and individualistic that it is no longer economical for one firm to make all parts necessary for an engine No firm in the world can attempt such a profitless venture It is stated that the Indian Cycle industry is unable to compete with the foreign industry mainly because 90% of the cycle parts have to be manufactured in one place The days of Robinson Cruso, the jack of all trades, have gone These are days of "put a

TABLE II

MATERIALS USED IN THE MANUFACTURE OF INTERNAL COMBUSTION ENGINE MAIN COMPONENTS

Component	Chief Stress in Service	Intensity of Service	Material used
Cylinder Block	High Tem Tension and abrasion	Heavy and Medium	Aluminum alloy, Cast Iron Medium carbon steel Nichrom Steel
Cylinder Heads	High Temp Tension & Bending	Heavy	Aluminum alloy Cast Iron
Cylinder Barrel	Tension	Slight	Mild Steel, Cast Iron
Cylinder Bolt	Tension and Bending	Medium	Medium Carbon Steel & Ni Steel
Crankshaft	Torsion,Bending, Shock and Vibration	Heavy	Nichrom Steel Alloy Cast Iron
Camshaft	Torsion, Abrasion and Bending	Heavy	Cast Steel or Nickel Case Hardened Steels
Connecting Rod	Compression, Tension, Bending and Shock	Heavy	Nichrom Steel, Alluminum Alloy, or Nickel Steel
Connecting Rod Bolt	Tension Bending & Vibration	Medium	Nickel Steel
Timing Gear	Shear Bending, Abrasion & Noise.	Light	Cast Iron Fibre
Fly Wheel	Tension & Bending	Light and Medium	Cast Iron or Medium Carbon Steel
Prop Reduction Gear	Shear, Bending, Abrasion and Shock	Medium	Chrom Molybdenum Steel or Nickel-Chrom Steel
Valves	High Temperature, Tension, Shock and Abrasion.	Heavy	Chromium-Silicon Steel, Nickel Chrom Steel, Silicon Molybdinum and Austentic Resisting Steels
Valve Springs	Tension, Bending and Surge.	Light	Chrom Vanadium or Manganese Silicon Steel, Special Spring Steels.
Valve Seatings	High Temp	Light.	Chrom Nickel Tungsten, Silicon Steels.

penny in a slot and press the button', when the worker has only a very small part in the making of a product

By the system of sub contracting not only can a thing be produced economically but will also facilitate the improvement of the product by constant research It is possible for every few organizations to have research sections where they can think of constantly improving their product A manufacturer of only piston rings accumulates a wealth of knowledge about the materials and performance of the rings and he will be in a position to put better rings everytime in the market because his product is backed by research An engine builder cannot compete with him, because he cannot devote so much attention to rings only as his canvass is wide

The internal combustion engine industry not only helps in the planning for higher living standard but will also usher 70 to 80 separate industries all over the country thus contributing to the industrial progress

Leaving the accessories to speciality manufacturers the engine builder generally makes the main components The name of the components, the chief stress in service the materials recommended are given in Table II Except certain special steels and aluminum alloys all the materials used are available in our country With the co-operation of the metallurgist it is not difficult to get the special alloys required This co operation is readily forthcoming provided the engine builder says exactly what he wants of the metallurgist The Bhadravathi Iron and Steel Works supplied special forgings of chrome nickel cobalt, and chrome molybdinum steel for exhaust and inlet valves required by the author for testing purposes India has made good strides in ferrous metallurgy during the last decade and all the raw materials with the exception of very few can be made available

Having procured the raw material the manufacturer converts it into a forging, casting or a fabricated part Forgings are preferred to castings in certain highly stressed parts The fact that a country like America possesses only very few forges shows that it is a highly mechanized and skilled trade which takes a long time to build up from a scratch Hence the Government should open with its vast resources a central forge to supply all types of forge blanks to engine manufacturers so that only the best quality material goes in engine making Similarly for castings it would be worthwhile to open a central foundry with the help of the Government so that all the castings can be supplied to industry are in good condition What is asked for is only national support and it should not be confused for nationalization

Such an idea is in harmony with the professed intentions of the Government regarding assistance to industries where private entérprise is not readily coming forth to start ventures of its own accord The Government supplying the raw materials will automatically have virtual control over the whole industry and at the same time there will be free scope for private enterprise to serve as sub contractors in a number of industries already mentioned

The task of the engine builder who gets the main components in the from of semi finished products from central forge and foundry consists of three main phases

(i) Material control which covers all process treatment

(ii) Machining and Assembly

(iii) Testing

Materials received must be inspected, checked and tested They should be properly heat treated before machining and passed on to the physical test department for the X ray examination to study internal conditions

Assuming satisfactory material control the major problem in engine manufacture is machining the parts to a high degree of accuracy and giving the required high quality finish It is important that all parts must be free from tool marks to avoid fatigue on highly stressed parts All steel parts have to be subjected to Magnaflux inspection for crack and chalk test is to be applied to all principal alloy castings and forgings It is necessary that the forgings must be machined in relation to grain flow established by laboratory sample stamping and all case hardened parts rechecked after grinding

As far as machining is concerned the engine components can de divided into three main groups

Group I Large items containing a number of machining hours In this category are crank case, cylinder block, crank shaft, super charger

Group II Parts of which a number off are required per engine In this category are connecting rods, valves or sleeves, valve gear, driving units

Group III Small parts of which only one is required per engine

For mass manufacture, line or group production is the only method to be considered for all parts in Groups I and II Careful planning would be needed to satisfy the requirements of line production, with full attention to transport and handling of all parts For parts in Group III, the usual methods are adopted of grouping machines according to type

The machine shop can be laid out into three main groups as follows

Group a Capstans, automatics, small steel parts, bearings

b Ferrous steel parts, of large proportion, crank case, cylinder block, super charger casing, miscellaneous

c Non ferrous parts, crankcase, cylinder block, super charger, casing, miscellaneous parts

The modern aero engine consists of thousand to thousand four hundred manufactured parts which may represent 12000 to 16000 operations all of which require jigs tools fixtures, and separate operation drawings

The variety and versatility of machine tools employed in machining engine components is increasing every day New machines are added on constantly which cut down machining time and improve the performance A good example of such a machine tool is a special transfer machine which drills, countersinks, reams and taps aluminium cylinder heads The first unit of this machine has sixteen stations at which 25 separate machining operations are performed with 64 tools The second unit has 53 stations where 46 distinct operations are performed with 70 tools All these operations are completed within two minutes The operators have only to insert the rough forging of the cylinder head at station 1 watch a control panel that instantly indicates which the machine goes wrong at any station and remove the finished head at the last station Even this machine is old enough for on a later model it is claimed that all these operations are performed in less than 40 seconds

This requires a keen sense for tooling a quality which is highly developed in the American technicians and skilled workers They always look forward to cutting down time effort and cost in manufacturing processes by developing automatic tools It is essential that our workers imbibe this sense

After machining the process work is rather extensive, It consists of prevention against corrosion and providing the required finish The anticorrosive treatment consists of the following,

(i) Chromate acid treatment for eletron castings
(ii) Anodic treatment for aluminum castings
(iii) Anodic eching for aluminum forgings
(iv) Cadmium plating for steel parts

Finishing consists of the following
(i) Coper plating
(ii) Nickel plating
(iii) Tin plating
(iv) Parkerising
(v) Chromium deposition for wearing parts

Most of these processes are closely guarded trade secrets and before we can apply them on a large scale, certain amount of research has to be carried out

TABLE III

MINIMUM MAN POWER REQUIREMENTS FOR THE MANUFACTURE OF AVIATION ENGINES

	Department or Section.	Number of Personnel Technical & Operative
A	Project Office and Models Section	12
B	Drawing Office Design Production and Modifications	400
C	Experimental Manufacture Fabrication Assembly and Experimental Foundry	1 000
D	Experimental Test Beds for Piston Engines and Gas Turbines	150
F	Experimental Test Beds for Single Cylinder Units Gas Turbine Combustion Chambers, etc	30
F	Metallurgical and Chemical Departments.	30
G	Rig Tests Electrical and Electronics Sections	50
H	Engine Installation Power Plant and Flight Test Dept	800
I	Inspection Departments —	
	(a) Experimental Engines	150
	(b) Production Engines.	375
J	Field Service Engineers (all grades)	75
K	Production Engines—Machining and Assembly	1 500
L	Production Engine Test and Despatch	60
M	Repair and Modifications Department for Production Engines Stripping Fitting and Reassembly	200
N	Spare Parts Production	300
	TOTAL	5 132

The Art of the Aviation Engine by F R BANKS C B O.B.E F R Ae S *Jour Roy Aero Soc 52,* (No 453) 541 1948

After processing and finishing the components flow into sub assemblies For convenience of manufacture an engine can be broken down into units which depend upon the type and design of the engine The assembly shop will have to be laid out so that the sub-assemblies flow easily into the assembly line After assembly the engine will go on to the test bed

All this requires enormous technical personnel F R Banks has made an estimate of the minimum man power requirements in the various relevant departments, which is shown in Table III The production figure of 1500 persons assumes a production rate of 1000 aero engines per annum for a model which takes 3000 man hours to machine, assemble and keep ready for test He also estimates that about 80,000 man hours will have to be expended in the designing and detailing of a large piston engine of 3500 h p The cost of developing a prototype engine is put between £ 10 to £ 20 per pound of structure weight, and the period of developing such an engine as two years These things are in relation to aircraft power plant But it may be mentioned that once the problem confronting aero engines are grappled with then it will be easy to appreciate the detail modifications omissions and additions to other fields of I C engines

The most important factor at the present moment is that of timing The world is progressing at a certain rate and unless the country progress at a rate greater than the average rate it may not be possible to catch up to the rest of the world Hence the question of timing in this industry cannot be over stressed

SUMMARY

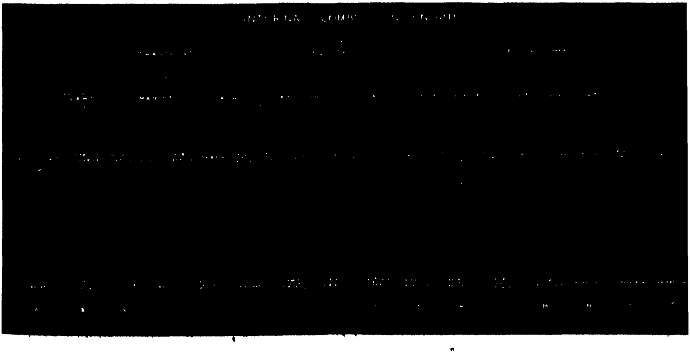
To sum up the I C Horse power developed per capita is a very important index of the prosperity of any country and there is an urgent necessity to step up this index by giving impetus to the manufacture of engines in this country This requires the cultivation of qualities *viz* , co operation, co ordination and attention to details in a large measure so as to place the industry on a sound foundation Sub contracting plays a vital part in building up of this industry and very able co ordination will be required at every stage Most of the raw materials required are available in the country and the help of the metallurgist can be easily enlisted in developing the special alloys required To catch time it is suggested that a central forge and a foundry should be started under the auspecies of the Government to supply semi finished products to individual engine builders Since the machine tool industry is still in its infancy the very highly developed equipments have to be procured from abroad in the first instance and at the same time the sense of tooling must be developed with a view to manufacturing them at an early date The technical personnel required for this job is enormous The talent is there in abundance, it must be recognized respected and properly employed No country which wants progress can be late and hence the importance of time in pushing these activities at a quicker pace

Thus the development of one industry will usher in an era of industrialization with a net work of sub industries spread all over the country contributing to the general prosperity, and enabling a higher living standards

BIBLIOGRAPHY

[1] B C Carter National Internal Combust on Engine Laboratory *Jr of the Board of Scientific and Industrial Research,* *7* 1948
[2] F R Banks Art of the Aviation Engine *Roy Aero Soc* *52* No 453 1948
[3] F Fairbrother Aero Engine Production *Aircraft Engineering 16* No 185 1944
[4] Wright Engine Production *Aircraft Production 4* No 37, 1941
[5] Ferrous and Non Ferrous metals used in Engine Construction *S A E Jr 40* No 4 1937

APPENDIX



A = Light Transport; B = Medium Heavy Transport, C = Rail Car Shunting & Locomotive D = Light Craft , E = Medium Sized Craft ; F = Light Air Craft ; G = Medium Size Air Craft , H = Heavy Air Craft , I = Sea Planes & Tanks ; J = High Dams, High Ways , K = Buildings & Bridges etc L = Farm Implements [Power] , M = Dairy Equipment N = Miscellaneous , O = Research ; P = Recreation

INTERNAL COMBUSTION ENGINES FOR

A	B	C	D	E	F	G	H
1 Motor Cycle 13–43 B H P AC SI 2 Private Car 63–165 B H P WC SI 3 Taxi Cab Same as (2) 4 Station Wagon 63 185 B H P WC SI 5 Genesal Purpose 63 85 B H P WC SI 6 Ambulance Van Same As (4)	1 P P Bus (Suburban) 81 210 B H P WC SI 2 P P Bus (Suburban) 81 210 B H P WC CI 3&4 P P Bus (Moffusil) Same as 1&2 5 Trucks 50 200 B H P WC CI 6 Trucks 50 200 B H P WC CI 7 Heavy Trucks 141 220 BHP WC SI WC CI For Transporting Bulldozers Mounted Cranes Cable Reels Drill Rigs Dollies etc	1 Shunting Loco 130 650 B H P WC CI 2 Rail Car 130–650B H P WC CI 3 High Speed loco (50–1200) BHP WC CI 1 2 3 are required on Broad Gauge Meter Gauge & Narrow Gauge H P Ranges as shown above	1 Out Board Motor 4–35 B H P WC SI 2 In Board Motor 50–500 B H P WC SI 3 Fishing boats 10 25 B H P WC CI 4 Tugs 75 300 B H P WC CI 5 Dredges 125 300 B H P WC CI 6 Ferries 25 75 B H P WC CI 7 Barges About 75 BHP WC CI	1 Passenger Vessel 75-300 B.H P WC CI 2 Cargo Vessels 75-300 B H P WC CI 3 Tankers 100 350 B H P WC CI 4 Ocean going Vessels 300 1000 B H P WC CI 5 Patrol Boats 150 300 BHP WC CI 6 Coasters 125 330 BHP WC CI 7 Trawlers 150 250 BHP WC CI	1 Club machines 50–100 B H P AC SI 2 Light Touring 100–250 B H P AC SI	1 Comml Aircraft 250–700 B H P AC SI 2 Large Comml 700–1200 B H P AC SI 3 Same as (2) WC, SI 4 Comml Air-Craft 500 1400 B H P WC CI	1 High performance Comml 1200–2000 B H.P AC SI 2 Same as (1) 2000 B H P Above AC SI 3 Same as (2) WC LC SI 4 Same as (1) WC or LC CI

INTERNAL COMBUSTION ENGINES FOR

I	J	K	L	M	N	O	P
1 Sea Planes 700 1200 BHP 2 Flying Boats Same as 1	1 Hammer Head Cranes About 150 HP WC CI 2 Whirler Cranes Same As 1 3 Batching Plant 5 50 H P AC S.I., WC C I 4 Belt Conveyor 5 20 B H P WC CI or AC SI 5 Power Shovels Upto 50 H P A C S I or WC C I 6 Tampers About 5 25 HP A C SI or WC C I 7 Caterpillars 25 135 BHP WC C I 8 Tractors 20 150 HP WC CI 9 Bull Dozers Same as 8	10 Excavators up to 50 HP WC CI 11 Pumping Sets 1 15 HP More WC CI 12 Washing and Mixing Plant 5 50 H P AC SI 13 Road Rollers, 60 150 BHP WC CI 14 Graders 50 150 BHP WC CI 15 Water Trucks 48 140 BHP W C S I 16 Concrete Mixers 5 10 H P A.C SI 17 Stone Crushers 8 20 HP AC S I 18 Motor Mills 5 15 HP AC S I 19 Earth Moving Equipment	1 Light Tractor 10 20 BHP AC SI WC CI 2 Medium Tractor 20 40 BHP AC SI WC CI 3 Heavy Tractors 40 60 BHP AC SI WC CI for 1 2 3 Seeding Planting Cultivating Harvesting Crop Processing Ploughing Haying Thrashing Winnowing Reaping Harrowing, etc 4 Lawn Mower 2½-4½ H P AC SI 5 Pumping 5 10 HP WC C I	1 Sheep Shearing 1 5 HP AC SI 2 Milking m/s 1 5 H P AC SI 3 Separators 1 5 HP A C S I 4 Pasteurisers 1 5 H P AC S I 5 Churners 1 5 H P A C S I 6 Refrigerator 1 8 H P A C S I	1 Fire Fighters 2 Washing mc/s	1 Ricardo Units 2 C F R Units 3 Experimental Engines	1 Racing Cars 2 Sports Cars 3 Working Models 4 Demonstration Display Model s.

PP = Public passengers, Figs in 0 Denote Total H P in its Class.
AC = Air Cooled; WC = Water Cooled, LC = Liquid Cooled; SI = Spark Ignition, CI = Compression Ignition.

Notes and News

OBITUARY

Sir Ardeshir Dalal

Sir Ardeshir Dalal, the famous industrialist and a past General President of the Indian Science Congress, died at his residence in Bombay on October 10 last

Born on April 24, 1884, Sir Ardeshir was educated at Elphinstone College, Bombay and St John's College, Cambridge He entered the Indian Civil Service in 1909 having stood first in the examination that year After serving for some years as Assistant Collector, and Collector in the districts he became a Deputy Secretary and later Secretary of the Revenue and Finance Departments to the Government of Bombay and Secretary to the Government of India in the Departments of Education, Health and Lands He retired from Government Service in 1931

Soon after his retirement from government service, he joined the House of Tatas and ultimately became a Director and Partner of Messrs Tata Sons Ltd, and Vice Chairman and Director in charge of Tata Iron and Steel Co Ltd He was also connected with several other industrial, commercial and banking organizations

At the Tatas, Sir Ardeshir effected many notable improvements in the condition of labour at Jamshedpur and was responsible for the introduction of a profit sharing scheme for its labour, the scheme being the first of its kind to be introduced in India In 1938 he was elected Chairman of the Indian Chamber of Commerce

Sir Ardeshir had the unique distinction of being elected General President of Indian Science Congress at its Banaras session in 1941 In his presidential address on "Science and Industry' he specially dealt on the Steel Industry in India and the progress of the Tata Iron & Steel Co Ltd (See *Science and Culture*, Vol 6 January, 1941 supplement)

Sir Ardeshir was a member of the Bombay Legislative Council (1924 26) and the Indian Legislative Assembly (1927) and a Municipal Commissioner of Bombay (1938 31) In latter capacity he carried out many important reforms notably the fight against malaria to which in a large measure the city owes its present immunity from that scourge

In 1944, Sir Ardeshir along with Sir Purshottamdas Thakurdas, J R D Tata, G D Birla, Sir Shri Ram, Kasturbhai Lalbhai, A. D. Schroff and John Matthai published a brief memorandum outlining a plan of Economic Development of India, generally known as "Bombay Plan" which had as its object of raising the standard of living for the common man of India by a process of planned expansion in industry, agriculture communication and the nation building activity

Soon after the creation of a new Department of Planning and Development in Lord Wavell's Government led to the appointment of Sir Ardeshir to this new portfolio Later, in 1946 he resigned the post, and the portfolio was abolished

Sir Ardeshir was knighted in 1939 and received the K C I E, in 1946

FAO CONFERENCE IN LUCKNOW

The biggest technical conference on Co operatives in Asia and the Far East, sponsored by the FAO was recently held at Lucknow from October 24 - November 2 last Delegates from Australia, Ceylon, France, Great Britain, India, Indo china, Pakistan and Thailand attending the conference, re affirmed their faith in the co operative movement as a solution to some of the rural problems of their respective countries Sri V L Mehta (India), Finance, Co operation and Village Industries Minister, Government of Bombay was elected chairman of the conference Representatives of ILO, SCAP, IFAP and ECAFE attended the conference as observers

Addressing the conference, Sri Mehta said "Shortage of essential commodities can never be tolerated by Governments for any length of time Any planned effort to remove such shortages postulates active co-operation of the community to overcome them Those who have assembled here have a firm belief in the potency of the co operative creed as a force which can enable us to lay the foundation of a new democratic and social order consistent with our adherence to the teachings of Mahatma Gandhi who always advised us to practice truth and non violence in all spheres of life "

The conference dealt with the problems connected with main types of economic co operatives and requirements for the successful development of rural co-operatives, with special reference to the functions and methods of Government, and the question of welfare societies

The conference passed resolutions recommending fiscal privileges and liabilities, audit and supervision of funds for co operative societies and suggested legislation for promoting the co operative movement The conference further recommended that Ministers in charge of co operation should have co-operation as their sole or major portfolio and that member countries should encourage education in co-operation by introducing it as a subject for study in primary and secondary schools, colleges and universities,

NOBEL PRIZE AWARDS

The Nobel Prize in Physics for 1949 has been awarded to the 42 year old Japanese physicist Prof Hideki Yukawa for his theoretical researches on nuclear energy Prof Yukawa was a professor in the Tokyo University during World War II and is now visiting professor of theoretical physics at Columbia University New York The Nobel Prize in chemistry for 1949 has been awarded to Prof William Francis Quanque of Berkley California

The Nobel Prize in Physiology and Medicine for 1949 has been jointly awarded to Dr Rudolf Hess of the Zurich University Institute of Physiology and Emeritus Professor Antonio Egas Moniz of Lisbon University

Dr Hess is the 68 year old eye and brain specialist and has been director of the Zurich Institute since 1947 Prof Moniz the famous 75 year old neurologist was the first man to cure a mental disorder by surgical operation in 1935 He is a former Portuguese Minister of Foreign Affairs and a Minister at Madrid

The Nobel Peace Prize was awarded to Lord Boyd Orr the 69 year old former Director General of U N Food and Agricultural Organization

The value of the prizes this year is worth £ 10 000 each

FOOD PROBLEM AND THE CULTIVATORS

Speaking on the food Problem at a meeting of the Royal Asiatic Society of Bengal on September 19 last under the auspices of the Rural Welfare Society Sri J N Chakravarty stated that food scarcity was not a new thing in India She has been facing it for over a century at the least She has been importing food for a considerable period but the position was aggravated by the partition leaving India to feed 80 % of the original population with 69% of rice and 65% of wheat areas The position of West Bengal was even more critical He thought however it was possible to meet the situation if scientific methods were adopted by the cultivators to increase crop yields He quoted figures to show that the I C A R had evolved improved strains of most crops and comparatively simple improved agricultural methods by the use of which crop yields could be raised by 30 % even under present limitations He gave his personal testimony that these figures were by no means overestimated and he had obtained similar results over different areas and under different conditions Even a 10% increase would practically wipe off present deficit of 40 lacs tons That this has not been achieved even in the course of forty years work of the agricultural department clearly demonstrated that the Government had not succeeded in popularising the discoveries of their research workers among the general body of the peasants This failure he ascribed as much to defective personnel as to the system within which the agricultural department had to work under the old regime The causes were due to

1 Lack of fully co ordinated, practical and realistic planning ignoring in many cases the limitations under which the peasant had to work and wage a daily war with nature to earn his living

2 Inefficiency and redtapism of the old Government It was not always realised that crops would not wait for formal sanctions Nor could they be hustled to grow nor cattle to breed to suit the convenience of the authorities that all preparations for cultivation had to be made months ahead

3 Lack of human contact with the cultivator The Govt machine approached the cultivators as another machine ignoring the human factor All plans however efficient depended for their successful execution on the personnel This fact was not given its due importance and there was lack of enthusiasm on both sides without which the schemes could not be successfully implemented The Govt machinery was not adapted to missionary work the only basis on which a department such as agriculture could successfully function

He stressed that the greatest single obstacle to India s radical agricultural improvement was the subdivision and fragmentation of holdings Against the world average of 2 acres India had only 7 and West Bengal 4 acres of cultivated areas per head For more than two thirds of West Bengal there were less than 2 acres per family This made machanised cultivation irrigation and many other improvements impossible of adoption This must be changed The cultivators must be given inalienable rights to their land and economic family units to cultivate The abolition of the Zamindary would be only the preliminary step

Holdings must be consolidated and redistributed to make mechanised and large scale farming possible According to his opinion the Russian method of collective farming is not suitable to Indian conditions because the plan would not be acceptable to the large body of Indian peasantry with their intense attachment to the family land and would lead to economic revolution which no democratic Govt could survive The solution lay according to him in co operative farming Whatever course was adopted it would threw a large body of agricultural labour out of employ for whom avenues of employment must be found by developing rural industries Another cause of stagnation of agriculture lay in the practical denudation of the villages of the middle class the backbone of any nation during the last half a century This has resulted in a neglect of the villages leading to all round degeneration of rural life and in upsetting the economy of the urban as well as of the rural areas This should be remedied Villages must be resusciated so that a considerable portion of the amiddle class now crowding into towns for petty clerkships may go back and assist in regenerating rural agriculture as well as industries All problems affecting rural life must be treated as one whole and the work coordinated under a single organisation Agriculture industry education sanitation must be treated as links in a single chain for lifting India out of the present stagnation

COSMIC RAY RESEARCH IN FAR NORTH

Cosmic ray research at 20 mile altitudes, near "the top of the atmosphere", over the Canadian out post settlement of Churchill on the shore of Hudson Bay has been undertaken jointly by the National Geographic Society and the Bartol Research Foundation of the Franklin Institute, Pennsylvania

A major objective of the expedition is to develop experimental evidence whether the sun is surrounded by a constant magnetic field similar to that possessed by the earth There is considerable scientific controversy on this subject Dr Martin A Pomerantz, the leader of the expedition, believes that a study of cosmic ray behaviour at high altitudes in the Far North may throw new light on the phenomenon

Data pointing to the importance of the project resulted from previous experiments conducted as far north as 52 degrees geomagnetic latitude and at altitudes of 30,000 ft , utilizing specially equipped B 29 s The geomagnetic latitude of Churchill, Manitoba, is roughly 69 degrees north (ten degrees greater than the more familiar geographic latitude), and this research program is being conducted at heights in excess of 100,000 ft or more than three times the altitudes possible in the B 29 tests

The theory under test is that cosmic rays should increase in intensity as the North Pole is approached since one is moving farther away from the equator where the earth's magnetic field is the strongest However, if the sun possesses a magnetic field of sufficient magnitude, its effect would be superimposed on that of the earth a magnetic field In that event, the intensity of these primary rays would remain constant north of a particular latitude

Previous research has established that primary cosmic ray particles (those impinging upon the top of the earth's atmosphere) are affected by the earth s magnetic field when they arrive from an as yet undetermined source or sources in outer space In fact the earth acts like a huge mass spectrograph in separating particles of different energies This phenomenon gives rise to what is called the latitude effect As one proceeds toward the equator, strongest zone in the earth s magnetic field, the rate at which cosmic particles arrive is ovserved to diminish This is caused by the exclusion of rays of lower energy

On the other hand, as the point of observation approaches the magnetic North Pole, it is expected that the rate of the arrival of the primary cosmic rays might continue to increase with increasing latitude unless there exists a solar magnetic field which interferes (*Journal of The Franklin Institute*, September, 1949)

PALOMAR'S SCHMIDT CAMERA

The world's largest partrol camera, 48 inches in aperture, is located on Palomar Observatory Until recently, the 48 inches Schmidt telescope has seemed over-shadowed by the new 200-inch telescope However the recent announcement of the new National Geographic Society—Palomar Observatory Sky Atlas has revealed the importance of this huge astronomical camera in conjunction with the program of the Hale reflector Of great value in their own right, the 14—by 14 inch Schmidt plates will be used to select objects and regions upon which astronomers will turn the 200 inch eye for special study The Schmidt survey will include the observation of many new objects, such as novæ variable stars, comets and asteroids

The equatorial mounting of the instrument is of the fork type, so that all parts of the sky may be photographed, and there are two guiding telescopes, each a 10 inch refractor with a focal length of 13 feet The two guiding telescopes enables the astronomer always to operate from the floor of the observatory, no matter to what portion of the sky the Schmidt is pointed The massively built fork has closed ball bearings in its polar axis and the tines of the fork are built with sufficient strength to minimize flexure differences The moving parts weigh 12 tons At the botton of the main tube is located the principal mirror, 72 inches in diameter with a radius of curvature of 240 inches, or 20 feet To prevent vignetting, the correcting plate (a 53 inch piece of plate glass) with its aspheric surface is considerably smaller than the principal mirror but even it is four feet in clear aperture It is mounted at the center of curvature of the primary mirror Midway between mirror and correcting plate is the focal plane Thus the focal ratio is 120 48 or f 2 5

The plates of the Schmidt survey will each cover an area of 36 square degrees, with a ¾ inch margin for overlapping The fields will have uniform definition and full illumination except in the four corners, where there will be a loss of about 1 20 magnitude, due to slight vignetting On the west side of the polar axis is the control board By this array of switches and controls the telescope is easily pointed and accurately driven (*Sky and Telescope*, September, 1949)

ELECTRON OPTICAL SHADOW METHOD

An 'electron optical shadow method for studying the basic magnetic properties of metals has been developed at the National Bureau of Standards The new technique, still in the experimental stage uses the electron as a probe to explore electric and magnetic fields of extremely small dimensions The patterns obtained may be photographed and the photographs used to measure and compute, to a high degree of accuracy, the "absolute value' of the magnetic field strength in the region of magnetic force Electric fields of force about an electrified object may be investigated in a similar manner

The method was developed in connection with a study of the magnetization of magenetic recording wire used to feed mathematical problems to a high speed electronic computing machine Possible applications of the method are in the field of ultra-high frequency equipment used in radar, radio, and television, and in improving the design of electron beam apparatus used in atomic physics (*Chemical and Engineering News*, September 12, 1949)

AUREOMYCIN A NEW ANTIBIOTIC

In a review appearing in the *Journal of the American Pharmaceutical Association*, Practical Pharmacy Edition, (*10*, 168, 1949) attention was called to Aureomycin, a new antibiotie prepared from *Streptomyces aureofaciens*

Aureomycin is amphoteric, and both its hydrochloride and sodium salts are known and both are soluble It is the hydrochloride which is commercially available, however, because of stability in solution At pH 8 5, for example, the drug loses 40% of its activity within two hours

Bacteriologically, the new drug appears to be more effective against gram positive organisms than against gram negative ones Because of instability of the drug at neutral and alkaline pH's, it is difficult to bioassay There is no evidence of drug fastness in the bacteria which have been studied *in vitro* Strains of organisms which have become resistant to penicillin and streptomycin respond readily to aureomycin Aureomycin has a low toxicity and appears to give no physiological action on the various body systems However, it is irritating on injection Although aureomycin is effective in many bacterial diseases, the most characteristic feature is its action in certain virus and rickettsial diseases It appears to be effective in cases of lymphogranuloma venereum, scrub typhus fever, Q fever, psittacosis, Rocky Mountain spotted fever, and in granuloma inguinale with a minimum of undesirable side effects (See also *Science and Culture 14*, 521, 1949)

NEW INSECTICIDE

A new insecticide many times more effective than DDT against roaches and houseflies was described at the 115th national meeting of the American Chemical Society

The chemical, a chlorinated hydrocarbon known only as Compound 497, is still lethal to roaches almost 2 months after it has been applied and is about 100 times as toxic to these insects as DDT, according to the report of Julius Hyman & Company, Denver, Colorado Against houseflies, a pound of Compound 497 does the work of 40 pounds of DDT, the report said, pointing out, moreover, that the new insecticide may become increasingly important in view of the fact that houseflies and some other insects are developing immunities to DDT Compound 497 is particularly recommended for spraying or dusting cotton, trees, and other non food products, where its high potency and prolonged activity are advantageous

A companion insecticide, Compound 118, appears to be suitable for food crops and is notably potent against grasshoppers, but unlike 497 it does not have an extremely long residual action, being virtually gone at the end of 3 weeks The results to date indicate that both chemicals will be safe if handled properly, although both are toxic to warm blooded animals and man It is for this reason that long lasting 497 is recommended only for non food use, while it is advised that the application of 118 to food crops be halted 3 weeks before harvest so that the insecticide will have time to dissipate Since the compounds are still in the experimental stage, they will not be available for general use until the 1950 growing season

MODERN WELDING TECHNIQUE

The wrought aluminium—magnesium alloys containing up to 7 per cent magnesium are stated to show promise as high strength weldable alloys, but have not been used to the extent which might be expected due to the development of internal porosity in the basis of metal adjacent to a weld bead The degree of such porosity increases with increasing magnesium content and decreasing welding speed The porosity is due to the reaction between the metal and water vapour forming atomic hydrogen, some of which diffuses into the metal to be rejected as molecular hydrogen at suitable interfaces The extent of porosity is markedly affected by factors tending to increase the hydrogen content of the metal, notably the presence of minor impurities, calcium in particular

The above magnesium alloy of low calcium and hydrogen content, was welded without developing internal porosity, and the mechanical properties of the welds were consistently good, *e g* welding efficiencies ranged from virtually 100 per cent to at least 60 per cent Cracking experienced in welds in an alloy of 2½% magnesium was divided by using filter rods containing 5 to 7 per cent magnesium

The application of resistance welding processes to the fabrication of light engineering assemblies is stated often to involve the problem of welding steel sheet which has previously been provided with their electrolytically deposited metallic coatings These coatings are intended either for protective purposes, or for the purpose of obtaining a good bond with paint which is subsequently applied, or both

It has been found in the past that the presence of certain metallic coatings on the surface of mild steel sheet tends to impair its resistance weldability The major difficulties introduced are, contamination of the resistance welding electrodes with the coating material, and lack of contact resistance at the points where it is intended to produce resistance welds

No difficulty was encountered in flash welding of any of the coated sheets, and the properties of the butt joints were comparable with those obtained in uncoated sheet

The production of spot welds in tin and tinzinc alloy coated sheet was found to be quite practicable, but closer attention had to be given to the selection of welding machine settings and to electrode maintenance than is necessary with uncoated sheet Tin-zinc alloy coatings were found to be better suited to spot welding than plain tin coatings

With plain tin coating electrode life was much shorter and adhesion of the electrode tips to the surface of the stock presented some difficulty The presence of zinc in the coating appeared to improve weldability considerably, compared with plain tin coating

The use of fully automatic welding machines is desirable for welding coated steels, because the success which can be obtained with the process depends largely upon the use of accurately controlled machine setting (*The Chemical Age*, *61*, 464, 1949)

BERYLLIUM BRONZE

Pure beryllium was isolated for the first time in 1947 in the laboratories of the Praz factory in Maurienne In view of the importance of this metal, production in the factory passed immediately from the laboratory to the workshop stage, and at the present moment the daily output is several kilograms at 99 9 per cent purity The beryllium bronze, which is also manufactured, is remarkably stable under an electric arc, its resistance to wear is seven times greater than that of phosphor bronze or aluminium bronze Because of its resistance to oxidation and corrosion its elasticity and good conductivity, it is used for electrical apparatus, precision machinery and other tools (*Chemistry and Industry* No 38, 654, 1949)

TRAINS MADE OF LIGHT ALLOYS

Between Paris and Strassbourg are put into operation trains made of aluminium alloys and mnounted on pneumatic tyres The aluminium alloy used contains 5% magnesium and 0 5% manganese It is highly malleable and has good mechanical properties and corrosion resistance The tyre consists of an inner tube and an outer cover, and the frame of the latter is made up of steel cables Extremely comfortable coaches weighing only 14 tons have been built in this way The interior decoration and fittings are modern, luxurious and most attractive (*Chemistry and Industry*, No 40, 641, 1949)

HARD STAINLESS STEEL

By a combination of extreme heat treatment and the deep freeze principle an American Company claims to have overcome the comparative softness of stainless steel of the type used for cutlery and similar purposes Knives made by the process are claimed to hold their keenness for three years and to be more resistant than carbon steel

Knife blades are first heated to a temperature much higher than that normally employed for this process The blades are then bathed in quenching oil at a temperature of 104° F Then they are placed in a specially constructed deep freeze chamber at sub-zero temperatures

After a suitable period of freezing they are again heated, to relieve the usual stresses and strains The blades are allowed to cool gradually to room temperature Finally they are tempered in the conventional manner to the desired degree of hardness (*The Chemical Age*, *61*, 464, 1949)

SWAMI JNANANANDA

Swami Jnanananda, one time a yogi practising meditation is now working in nuclear physics in the National Physical Laboratory at New Delhi

After a period of over ten years of *yoga* and meditation, Swami Jnanananda left for Europe in 1927 for higher studies in science He was interested in mathematics, physics and philosophy and took his Doctorate in Science from the Prague University While in Europe, he delivered speeches on Vedanta Philosophy in relation to that of Kants' System

After the declaration of war in 1939, Swami Jnanananda left Germany for England and worked in the laboratory of Sir James Chadwick He is a Fellow of the Institution of Physics In December **1944**, he left U K for U S A where he continued his researches on radio-activity He is the author of an important book, "*High Vacua* "

ANNOUNCEMENTS

Dr Pratul Chandra Mukherji has been awarded a Senior Research Fellowship by the National Institute of Sciences of India to work on the Synthesis of Steroid Sex Hormones and related Compounds" at the University College of Science and Technology, Calcutta University

The Indian Oilseeds Committee has made a grant of Rs 60,000/ only spread over in three years to the Bose Research Institute, Calcutta for a scheme of investigation for inducing mutants with economic characters in til (*Sesamum*), Rape and Mustard (*Brassica*) by X rays The investigation will be carried out under the direction of Dr K T Jacob, Head of the Department of Botany

ERRATA

In the August 1949 issue of Science & Culture on page 73 para 4, line 13 read *A irregularis* for *A irregularies*

On p. 74 in the Table :

3rd Column the bibliographic reference should read Davies 1940 *for* Davies 1924

5th Column the bibliographic reference should read Davies and Pinfold 1937

6th Column the bibliographic reference should read Rao 1941.

7th Column : the bibliographic reference should read Clegg 1938, Cotter 1938A, Evans and Sansom 1941.

LETTERS TO THE EDITOR

[*The Editors are not responsible for the views expressed in the letters*]

SUGARCANE (*SACCHARUM OFFICINARUM*) TOPS AS FEED FOR CATTLE

The inadequacy in the supply of food stuffs for the livestock in India can not be over emphasized According to a recent estimate[1] the available supply of digestible protein and starch equivalent from all organized sources are 30 0 and 41 0 per cent respectively of the required amounts This shortage is not only of quantitative nature but qualitative also because straws which are nutritionally poorer than the cultivated fodders, constitute more than 50% of the total roughage supply Hence it becomes imperative to tap, hitherto unutilized sources as well as make full and economical use of available substances

Sugarcane forms one of the important cultivated crops of India the area under sugarcane for the years 1940 41 being about 4 8 million acres[2] After the disposal of sugarcane for the manufacture of sugar cane tops remain as a by product The estimated yield of sugarcane tops in India roughly works out to 16 million tons annually Till now no economical use has been made of this huge supply and it has been rather allowed to be wasted Major proportion of sugarcane tops is allowed to be dried up in the fields to be burnt away later as fuel during the manufacture of *gur* and sugar Only an insignificant fraction of the total yield is utilized as cattle feed Hence an experiment was conducted in these laboratories to evaluate sugarcane tops as to their palatability and nutritive value

Sugarcane tops were chemically analyzed and the results along with the analysis of a few commonly grown green feeds are presented in table I

TABLE I

CHEMICAL COMPOSITION OF SUGARCANE TOPS AS COMPARED WITH SOME COMMON GREEN FEEDS

Name of Feeds	Crude protein	Ether extract	Crude fibre	Nitrogen free extract	Total Carbohydrates	Total ash	Calcium Cao	Phosphorus P_2O_5
Sugarcane tops	5 47	1 48	28 76	56 03	84 79	8 26	0 57	0 463
Napier grass	5 35	1 89	31 9	44 16	76 06	16 70	0 46	0 80
Sudan grass	5 68	1 89	27 03	51 01	78 04	14 39	1 19	1 33
Jowar (ripe)	4 63	1 16	38 66	47 49	86 15	8 06	0 35	0 48
Maize	6 74	2 09	35 95	47 07	83 02	8 15	0 73	0 63

It will be seen from the table that as regards crude protein, sugarcane tops are richer than *jowar* (ripe) and poorer than maize, comparing favourably with Napier and Sudan grasses. The total carbohydrates content of sugarcane tops is however, higher than that of Napier and Sudan grasses, comparing with that of *jowar* (ripe) and maize The calcium content of sugar cane tops is higher than that of Napier grass and *jowar* (ripe) and less than that of maize and Sudan grass, whereas its phosphorus content is lowest in the list

Feeding trials with sugarcane tops were conducted on two species of animals namely *Kaumani* bullocks and buffaloes Two well matched groups, one consisting of three *Kaumani* bullocks and the other three buffaloes were selected The daily ration consisted of chaffed sugarcane tops fed *adlibitum* to all the animals, supplemented by 120 gms of rape cake per animal to meet the digestible crude protein requirements In addition, each animal was given 1 oz of common salt daily The feeding was continued over a period of five weeks During this period animals presented a healthy appearance and added on an average over the initial weight, 7 lbs in case of buffalo group and 3 lbs in case of *Kaumani* bullock group

After twenty five days of preliminary feeding, a metabolism trial was conducted on animal in both the groups The average digestibility co efficients were found to be crude protein 48 87, ether extract 45 68, crude fibre 53 53 and nitrogen free extract 46 62, for the *Kaumani* bullock group and crude protein 46 59, ether extract 42 5, crude fibre 54 13, and nitrogen free extract 47 58 for the buffalo group The nutrients in lbs per 100 lbs sugarcane tops (dry basis) were found to be digestible crude protein 2 672, total digestible nutrients 45 707 and starch equivalent 28 635 for the *Kaumani* bullock group and digestible crude protein, 2 548 total digestible nutrients 46 197 and starch equivalent 29 148 for the buffalo group A comparison of the nutrients per 100 lbs of sugarcane tops (dry basis) with some other green feeds is given in the following table II

From the above table, it will be observed that in digestible crude protein sugarcane tops are richer than

TABLE II

Name of feeds	Digestible crude protein	Total digestible nutrients.	Starch equivalents
Sugarcane tops (*Kaumani* bullocks)	2 672	45 707	28 635
Sugarcane tops (buffaloes)	2 548	46 197	29 148
Sudan grass	1 57	44 41	28 4
Jowar (ripe	1 16	53 40	30 8
Maize	4 14	68 28	46 7

Sudan grass and *jowar*(ripe) though as regards total digestible nutrients and starch equivalent the figures of sugarcane tops lie in between those of Sudan grass and *jowar* (ripe)

The results of the nitrogen calcium and phosphorus balance study are shown in the following table III

TABLE III

NITROGEN CALCIUM AND PHOSPHORUS BALANCES

	Kaumani Bullock Group (average of 3 animals)	Buffalo Group (average of 3 animals)
Nitrogen (N)	+7 12	+9 24
Calcium (CaO)	+0 76	+1 25
Phosphorus(P_2O_5)	+2 65	+2 05

It will be seen from the above table that the balance for nitrogen is highly positive in both the groups The balances for calcium and phosphorus are also indicated to be positive on an average

These observations point out that cane tops can form a satisfactory fodder for cattle, and, instead, of being a waste, as at present, they can be economically very well utilized and thus add to the prosperity of the cultivator

N D KEHAR
B SAHAI

Animal Nutrition Section,
Indian Veterinary Research Institute,
Izatnagar 10-6-1949

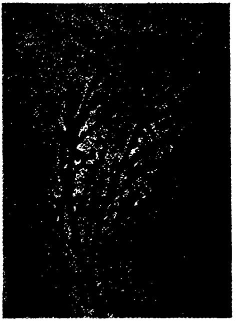
---

[1] Kehar, N. D Proc. Ani. Husb Wing Meeting P 1, 1949

[2] Burns, W. Technological Possibilities of Agricultural Development in India, 1944.

PHYLLODY IN *BOTRYCHIUM VIRGINIANUM* Sw

In a group of *Botrychium virginianum* Sw plants collected in Kodaikanal Hills, South India, the writers noticed stray cases of the occurrence of phyllody in the fertile spikes Normally the fertile spikes are borne on upright stalks and show pinnate branching In the malformed spikelets, the transformation of the sporangia into sterile vegetative pinnules were noticed in large numbers Gradation of malformation from small scale leaves to well expanded leafy structures could be observed in the same fertile spike (Figs 1 & 2)



Showing the trasformation of Sporangia into sterile leaves X nat size

Enlarged view of the same X 2

Teratological phenomenon in the fertile spikes of the Ophioglossales and their importance has been pointed by Bower [1] While the occurrence of phyllody has been reported in some members of the Ophioglossales, an interesting situation has been recorded in two species of *Botrychium* In *B Lunaria* (Goebel[2]) and *B simplex*, the development of sporangia by the transformation of the sterile vegetative leaf has been reported In the case under study however, the situation is different, the fertile spike has become transformed into vegetative leaves In view of the controversial questions about the nature of the fertile spike a detailed morphological study of similar teratological phenomena among the Ophioglossales may throw some light

The authors wish to express their sincere thanks to Dr M J Thirumalachar for kind help and valuable guidance

H C GOVINDU
H S NARAYANA

Agricultural College, Bangalore,
15 6 1949

---

[1] Bower F O The origin of a land Flora, 441 443, 1908
[2] Goebel K Organography of Plants 2 474 477 1905

PROBABILITY DISTRIBUTION OF POINTS ON A LINE

Recently one of us[1] has obtained the first and the second cumulants for the distribution of the total number of joins between points of different colours when *m* points belonging to *k* colours are arranged at random on a line The probabilities of the points taking the different colours, say, black, white, etc, are independent of the colour of other points and are

$p^1, p^2 \quad p_k$ such that $\sum_1^k p_r = 1$ The present communication gives the third and the fourth cumulants of the distributions and also the difference equation of the moment generating function

$$k_3 = (m-1)a + 6(m-2)b + 6(m-3)c - 12(2m-5)ab - 3(3m-5)a^2 + 4(5m-11)a^3,$$

$$k_4 = (m-1)a + 14(m-2)b + 36(m-3)c + 24(m-4)d + 7(3m-5)a^2 - 12(5m-16)b^2 - 72(2m-5)ab - 24ac(5m-17) + 24(5m-11)a^3 + 24(15m-44)a^2b - 2(105m-279)a^4;$$

Where $a = 2(1^2), b = \{(21) + 6(1^3)\}$
$c = \{2(2^2) + 6(21^2) + 24(1^4)\}$, and
$d = \{(32) + 2(31^2) + 36(21^3) + 12(2^2 1) + 120(14)\}$,

in which $(l_1^{\pi 1} l_2^{\pi 2} l_3^{\pi 3} \quad)$ stands for the monomial symmetric functions in $p_1, p_2, \quad p_k$

The above two expressions are linear in *m* and we have already seen[1] that k_2 also is linear in *m* Hence r_1 and r_2 tend to zero as *m* tends to infinity Therefore the distribution tends to the normal form as *m* tends to infinity

The difference equation of the moment generating function of the distribution reduces to the form

$$M_m = M_{m\ 1} + 2(1^2)\,\theta\, M_{m-2} + \sum_3^k \theta^r\,(r-1)\,(1^r)\,M_{m-r},$$

where M_m represents the moment generating function of the distribution for *m* points and θ stands for $(e^{it} - 1)$

P V KRISHNA IYER
B V SUKHATME

I C A R, New Delhi,
9-8 1949

---

[1] Iyer, P V K J *Ind Soc Agric Stat* 1, 173, 1949

METALLIC COMPLEXES OF TARTARIC AND CITRIC ACIDS

Organic hydroxy acids generally form complexes with metallic ions It is a common observation that presence of tartaric acid and tartrates often interferes with the quantitative estimation of Copper Considerable work has been done on the study of complexes formed but none is very conclusive The author, by means of different physico chemical methods *e g*, thermometry, conductometry, absorption measurements, etc has undertaken a thorough investigation on the nature of the complexes formed between organic hydroxy acids (tartaric, citric, etc) and various metallic ions in solution The result of the work done with Copper and tartaric acid and of Copper with alkali tartrates are given below

Earlier work [1] [6] with Copper and alkali tartrates is confined only to the isolation of the blue compound formed in Fehling's solution and in the investigation of the supposed cupritartrates The complex formed by Copper with tartrate was found to be in the proportion of 1 1 by the measurements of E M F, electrical conductivity, optical rotation and absorption spectra [7,8] That Copper forms no complex with tartaric acid but only with tartrate and that also in the proportion of 1 1 was observed by Bobtelsky and Jordan

From a study of electrical conductivity and absorption in the visible region, it was found by the author that both the free acid and the tartrate form with Copper complexes in the proportion of 1 1 (1) Besides, it was observed from a measurement of absorption in the ultra violet region that with tartrate Copper forms another complex containing one metal and three tartrate ions (1). Jobs' method of continued variation has been applied to determine the instability of the complexes The mean value of K, the instability constant for the complex (1) above with free acid was found to be 1 21 × 10^{-2} and that with alkali tartrate 7 0 × 10 . In this investigation equimolecular solutions of tartaric acid, Sodium-potassium tartrate and Copper nitrate in different concentrations were used Citric acid behaves similarly as tartaric acid Fuller details of the work will be published elsewhere.

The author is grateful to Prof P B Sarkar, University College of Science, Calcutta, for valuable discussions, Prof A K Majumdar for taking interest in this work and to Prof S N Mukherjee, for sparing the conductivity measuring Bridge and the Lumetron to carry out the work

R N Sen Sarma

Inorganic Chemistry Laboratory
College of Engineering & Technology Jadavpur
W Bengal Calcutta-32 7 9 1949

[1] Masson and Steele *J C.S* *75* 725 1899
[2] Pockering *Ibid* *99* 169 1911
[3] Packer and Wrack *Ibid* *199* 1348 1921
[4] Pickering, *Ibid* 1837 1910 1347 1911 174 1912
[5] Wrack *Ibid* 1815 1826 1923 1753 1927
[6] Dunansky and Chalisew *Kolloid Z* *47* 121 1928
[7] Jellinek K. and Gordon H *Z Physik Chim* *112* 207 49 1949
[8] Shinichiro and Hakomorik *Sc Repts Tohoku Imp Univ* *16* 841 59 1927
[9] *Bobtellsky* M and Jordon J *J A C.S* 67 1824 1945
[10] Job *Compt Rend* *180* 928 1925

THE FERRIC THIOCYANATE PARADOX

The formation of intense red colouration by the reaction between ferric and thiocyanate ions in solution has been utilised in the detection of either of the constituents in chemical analysis

The red colour was formerly believed to be due to unionised molecules of ferric thiocyanate Fe $(SCN)_3$

Schlesinger and Valkenburg[1] have observed that ferric thiocyanate is dimeric in benzene and ether and during transport measurement in non aqueous solutions the red component moves towards anode which indicates that the complex ion must be a bearer of negative charge So they concluded that ferric thiocyanate in solution should be formulated as Fe $[(SCN)_6]$ Such a formulation is untenable since it makes the ferric thiocyanate molecule an electrolyte capable of undergoing dissociation into Fe^{+++} and $[Fe(SCN)_6]^-$ ions in solution which however is not confirmed by transport experiments conducted in solutions containing Fe^{+++} and SCN ions in the proportion corresponding to the formation of the $Fe(SCN)_3$ molecule Furthermore, the solubility of $Fe(SCN)_3$ in organic solvents like benzene and ether is in keeping with the non ionic nature of the complex

Moller[3] from conductivity and spectro photometric measurements have come to the conclusion that in ferric thiocyanate solution the following mobile equilibrium exist

$$Fe^{+3}+SCN^- = [Fe(SCN)]^{+2}$$
$$[Fe(SCN)]^{+2}+SCN^- = [Fe(SCN)_2]^{+1}$$
$$[Fe(SCN)_2]^{+1}+SCN^- = [Fe(SCN)_3]$$

According to Moller the migration of red colour to the anode during transport experiment is due to the presence of a negatively charged colloidal basic ferric thiocyanate

But this explanation is not tenable since the migration of the red compound even in presence of large excess of acid is observed Moller has further suggested that at a very high concentration of thiocyanate ion, the negatively charged complex ion $Fe(SCN)_4^-$ may also exist

Later the ferric thiocyanate reaction has been studied by Bent and French[4] Edmonds and Birnbown[3] and Vosburg and Gould[5] They are all of opinion that the red colour is due to the complex $[Fe(SCN)]^{+2}$ and not due to unionised $[Fe(SCN)_3]$ Recently A K Babko and Kodenskaya[6] have studied the reaction between Fe^{+++} and SCN^- ions from investigation of absorption spectra of solutions containing those ions both in aqueous and non aqueous solvents

In the former case they have obtained indication of the formation of complexes of the nature $Fe(SCN)_x$ where $x=1$ to 5 formed with increasing concentrations of SCN^- and they have also been able to determine the equilibrium constants of the complexes in all the cases

Confirmation of the stepwise complex formation was obtained from electrolytic transferance determination of solution containing 2×10^{-5} mole/Fe^{+3} and from 1×10^{-2} to 4×10^{-1} mole/SCN At 1 to 2×10^{-2} mole/SCN the coloured layer moves towards the cathode, between 5×10^{-2} and 10×10^{-2} the motion is indefinite resulting in blurred boundaries on both sides while at 2×10^{-1} to 4×10^{-1} the motion is distinctly towards anode

In 90% EtOH and 90% Me_2CO solution absorption measurements have also indicated formation of SCN^- rich complexes with increase in Fe^{+3} ion concentration coloured layer migrates to cathode while with substantial increase in SCN^- concentration it moves to anode

In EtOH solution approximate determination of the equilibrium constant of the complex ion $[FeSCN]^{+2}$ has been made, the low value showing that dissociation is strongly decreased in non aqeuous solvents

In Me_2CO, Et_2O EtOAc and AmOAc it has been shown the $FeCl_3$ and KSCN forms only $Fe(SCN)_3$, only in EtOH $FeCl_3$ forms $Fe(SCN)_2^+$

The present author has studied the reaction systematically by thermometric method of Dutoit

The thermometric titration curves of ferric alum solutions and ferric nitrate solutions with solutions of Potassium thiocyanate and ammonium thiocyanate show for breaks corresponding to the complexions $[FeSCN]^{++}$, $^+[Fe(SCN_2)]^+$, $[Fe(SCN)_4]^-$ and the neutral molecule $Fe(SCN)_3$ These breaks are found to be independent of concentrations of either of the reactants and therefore indicate true compound formation in solution The reverse titration i e the titration of potassium or ammonium thiocyanate with ferric nitrate or alum also indicate the formation of the same type of species in solution as in the case of direct titration but in the reverse order From the results of thermometric titration it may be concluded that in ferric thiocyanate solution the following mobile equilibria exist

$$
\begin{aligned}
Fe^{+3}+SCN &= [Fe(SCN)]^{+2}\\
[Fe(SCN)]^{+2}+SCN &= [Fe(SCN)_2]^{+}\\
[Fe(SCN)_2]+SCN &- Fe(SCN)_3\\
Fe(SCN)_3+SCN &- Fe(SCN)_4
\end{aligned}
$$

This method gives a direct evidence as to the formation of at least the first four of the complexions in solution as postulated by the foregoing workers by a single titration

The author expresses his regardful thanks to Prof P B Sarkar Ghosh Professor of Pure Chemistry for kindly suggesting the problem and giving full facility for carrying out the work in his laboratory

KUMAR KRISHNA CHATTERJI
Ghose Prof s Laboratory
University College of Science & Technology
Calcutta 12 9 1949

---

[1] Schlesinger and Valkenburg *J A C S* pp 1212 1931
[2] M Moller Kem Manesmadblad *Chem Zentr* 1938 1937
[3] Edmonds and Birnbown *J A C S* 1941
[4] Bent and French *J A C S* pp 568 72 1941
[5] Gould and Vosburg *J A C S* 1941
[6] A K Babko and V S Kodonskaya (*Comp Rend Acad Sci.* U S S R *52* 37 8 1946 *J Gen Chem* U S S R *16*, 1549-60 1946 1080 8 1947)

STUDIES IN INDIAN TURPENTINE PRODUCTION OF p CYMENE (3)

India has to depend upon *Pinus longifolia* Roxb as her source of turpentine oils at least for some time to come as *P excelsa* turpentine is neither being produced at present nor is there any likelihood of its being produced in the near future [1] Dupont[2] in his investigation of various turpentine oils found that while American French Italian and Cuban varieties are entirely free from carenes Russian II and *P longifolia* turpentine of India contain this particular fraction to the extent of 32 5 % and 37 6% respectively

A detailed study of turpentine oils (*P longifolia* Roxb) obtained from different localities in this country has been made in this laboratory An analysis of quality I oils manufactured at Jallo (N W R W Pakistan) Hoshiarpur (East Punjab) Miransahib (J & K State) and at Clutterbuckganj (Bareilly U P) has revealed that the carene content (Boiling range 164° to 169°C) is much higher than that given by Dupont[2] and generally varies between 50 to 70% and to this high carene content which is particularly susceptible to auto-oxidation and polymerisation must be ascribed the tendency of Indian turpentine oils to undergo deterioration on ageing.

Attempts have therefore been recently made to find an industrial outlet for this fraction other than its use as a thinner in paints and varnishes Verghese and others[3] attempted to prepare *p* Cymene but did not meet with much success However Sondhi and others[4] who made an intensive investigation into high temperature catalytic dis-proportionation and dehydrogenation of carenes were able to prepare p cymene in fairly good yields by using partially dehydrated gypsum as the dehydrogenation catalyst at 500°C

Some more catalysts have now been studied and it has been found that Chromic oxide first introduced as an organic dehydrogenation catalyst by Ipatieff[5,6] and Sabatier[7] also gives high percentage conversion of carenes to p cymene

Preparation of catalyst Aluminium hydroxide which was precipitated from aluminium sulphate was washed well and was then kept at 60° to 75°C for ten hours The resultant mass was cut into pea size pellets and was impregnated with a solution containing the calculated amount of chromic acid Complete dehydration was effected by heating in a kaolin crucible at 400°C for 0 5 hour

Re activation to the original activity was brought about by blowing a vigorous stream of air through the used catalyst for 1 5 to 2 0 hrs at 400° to 500°C

Carenes (Boiling range 163° to 168°C/745 mm d^{15} 0 4868 n^{20} 1 471 $[\alpha]_D^{24}$ 21°-42) were kept over fused calcium chloride overnight before being used for pyrolysis The pyrogenic unit was similar to the one employed by Sondhi *et al*[4]

TABLE I

EFFECT OF TEMP ON CARENE VAPOURS USING CHROMIC OXIDE DEPOSITED OVER ALUMINA 16% CONC AS THE CATALYST L H S V 0 21

No	Temp range C	% yield on wt. of carenes at °C			
		300	350	400	450
1	Gases	7 1	12 1	22 5	38 1
2	75	0 8	1 6	0 0	0 8
3	75–100	0 8	1 6	0 6	5 0
4	100–120	0 8	0 0	0 8	1 2
5	120–143	4 2	2 5	1 6	0 0
6	143–163	7 5	5 8	6 6	8 9
7	163–173	21 8	13 4	13 3	13 5
8	173–178	30 6	38 2	26 6	10 6
9	Residue	25 2	24 3	26 6	17 8

TABLE II

CONSTANTS OF FRACTIONS BOILING AT 173–178°C OBTD *V de* TABLE I

No	Temp ± 15°C	% yield on wt. of carenes	Iod No.	n^{24}
1	300	30 6	86 4	1 4720
2	350	38 2	75 4	1 4768
3	400	26.6	63 4	1 4860
4	450	10 6	98 1	1 4870

TABLE III

CONSTANTS OF FRACTIONS BOILING AT 173° 178°C OBTAINED BY PYROLYSIS OF CARENES OVER CHROMITE CATALYST 20 % CONC 1 H.S V 0 21

No	Temp. ± 15°C	% yield on wt of carenes	Iod No	n^{20}
1	300	32 0	80 1	1 4701
2.	350	40 0	71 2	1 478[illegible]
3	400	46 6	48 0	1 4865
4	450	12 3	80 1	1 4876

TABLE IV

CATALYST CONC 24%., 1 H.S V 0 21

No	Temp ± 15°C	% yield on wt of carenes	Iod No	n^{20}
1	300	21 8	79 9	1 4871
2	350	23 1	63 2	1 4873
3	400	17 9	80 8	
4	450	7 8	77 5	—

Thus we find that 20% conc of chromic oxide over alumina at 400°C gives the best results Refractionation of the pyrolysate from which 173° to 178°C fraction had been tapped off increases the yield by 8 to 9% Total conversion into p cymene therefore is about 55% with an iodine no 48.0 On the basis of menthadienes the % purity of this product would be about 85%

Complete purification could be effected by shaking the crude produce with 80% sulphuric acid in cold and subsequent washing and steam distillation The final product obtained corresponds in all respects to pure p cymene prepared from crude terpineol by Sondhi, Bhusan Gulati and Joshi[8] Attempts are being made to effect purification by the method of preferential solubility

I am grateful to Shri R N Singh General Manager of Ind Turp & Rosin Co Ltd and Ind Bobbin Co Ltd for having provided facilities without which this work could not be possible

Chemistry Laboratory
Indian Turpentine & Rosin Factory
Clutterbuckganj Bareilly U P
8-2-1949

H K SONDHI

Guha and Roy *J Inst Sc* *3A* Part XIII 201 225

[2] Dupont G *Ann. Chim* (10) *1* 184 1924

[3] Verghese, Bhushan Gulati and Joshi *J I C S* Ind & News Edition) *7* 93 1944

[4] Sondhi Bhushan Gulati and Joshi *J I C S* (Ind & News Edition) *10* 17 1947

[5] Ipatieff *Ber* *34* 596 3579, 1901 *Ibid* *35* 1047 1902

[6] Ipatieff *J Russ Chem Phys Soc* *34* 18- 1902 *Ibid* *40* 500 1908

Sabatier P *Ann Chim Phys* *147* 16 106 1909 *Ibid* *148* 1734 1909

[8] Sondhi Bhushan Gulati and Joshi *J I C S* (Ind & News Edition) *10* 24 1947

BOOK REVIEWS

Electric Resistance Strain Gauges—By W B Dobie, M Sc and Peter C G Isaac, B Sc (Eng) A M I C E The English Universities Press Ltd St Paul s House Warwick Square London E C 4 Cloth Demy 8 vo Pp xiv+114 1948 (Sh 15 net)

To an engineer familiar with the modern developments in stress analysis, especially those who are in touch with the Proc of the American Society for Experimental Stress Analysis, this book will appear to offer very little fresh ground In fact it attempts to cover within, a small compass too wide a field and includes chapters on electronics and mathematics which are more adequately covered in other texts However as the subject in question has been mostly treated in scattered English and American technical journals and orderly and compact collection of matter on strain gauges under one cover fulfils a worthy purpose

Electric resistance strain gauges were first evolved in America about a decade ago and then considerably developed on a practical scale during the war especially in the aircraft industry To day they form an important tool of useful structural research useful in varied spheres Noted for his manifold researches in pure and applied science Lord Kelvin is also credited with the discovery of enunciating a strain resistance change relationship for metal wires a principle on which the working of the modern electric strain gauge is based The gauge consists essentially of a short length of wire held in intimate relation to the material under test so that any strain coming on the material is transmitted to the gauge This strain gives rise to a change of resistance which is then accurately measured either by a simple bridge or a simple potentiometer circuit The underlying principles are set forth by the authors against a background of elastic strain theory and supplemented by descriptions of the various types and uses of gauges The subject of elementary electronics including cathode ray oscillographs, amplifiers, and rectifiers is also discussed in the latter half of the text together with a survey on electronic-bridge circuits and special problems encountered in dynamic strain recording There are two major advantages in using electrical strain gauges viz the attainment of an unlimited scale of amplification and special suitability for remote readings and telemetering The authors do not appear to have stressed these vital points, as this reviewer has failed to find any reference to their applications such as in recording the experimental runs of automobiles, airplanes, guided missiles and submarines by pulse time modulation methods Besides an inclusion of topics on fatigue properties of guages, behaviour of gauges under hydrostatic pressure at low temperatures and in soil mechanics problems such as the determination of actual load transfer from driven piling to the soil mass, would have increased the worth of this publication Nevertheless as the first book of its kind on this subject, some of these shortcomings can be overlooked and the text can be recommended to those who desire to pursue a course in strain gauge methods of experimental stress analysis

S K G

Absorption Spectrophotometry—By G F Lothian, M A F Inst P, Pp 196 Illustrations 71 Hilger and Watts Ltd London 1949 Price 26s net

The second edition of the well known Hilger publication, '*The Practice of Absorption Spectrophotometry with Hilger Instruments*, by Mr F Twyman and Dr C B Allsopp, appeared in 1934 Although the present volume is based on the earlier book, it has been so completely revised and largely rewritten that it appears as a new book It is a valuable hand book for the measurement of absorption spectra in the ultraviolet, visible and infra red regions of the spectrum by photographic, visual and photoelectric methods The book is divided into three parts dealing with the general principles of spectrophotometry, its applications to specific problems and the techniques of measurement

In the first two chapters, the application of absorption spectra of liquids or solutions to the elucidation of problems of molecular structure, and the explanation of the absorption phenomenon in the light of quantum theory have been well presented The laws of absorption of electromagnetic waves by different media, the validity of the laws in practical problems and the real and apparent departures of the laws in different conditions, such as the finite wave band, the effect of pressure broadening, and the diffusing media have been thoroughly discussed in Chapter III Chapter IV deals with the various features of a spectrophotometer and the various means of photometry which will determine the greatest accuracy for a particular problem in spectrophotometry Part I of the book ends with a chapter on the methods of calculation for quantitative analysis of simple solutions and of complex mixtures, with particular reference to some cases in which Beer's law is not obeyed.

Part II deals with the applications of ultra-violet spectra and of Infra-Red spectra to structural chemistry with specific examples of absorption spectra of some compounds and their chemical structures The analytical applications in dye industry for determining the concentration and purity of a dye, and in biological and biochemical problems for identification and estimation of immunological precipitates have also been stated briefly

In Part III of the book, the technique of visual, photographic and photoelectric spectrophotometry and the description of a set of instruments used for these have been treated fully well For work in the Infra Red regions of the Spectrum various thermal detectors have been described

It is a very valuable book for investigators on spectrophotometry, because it not only describes the technique and apparatus used, but also states the conditions for obtaining accuracy in specific problems Investigators on this field must thank the author for the compilation of recent works in the book

B M

Structural History of the East Indies—By J H F Umbgrove The University Press, Cambridge 1949 Pp 163 with 10 plates and 68 figures in the text Price 30s

Yet another remarkable work of the famous Dutch geologist Dr Umbgrove, about a region which is perhaps the most inviting to geologist, is a welcome addition to our knowledge of the festoon of islands that swing round the Equator in the East Indies The present volume has grown from a series of lectures delivered by the author to the students of geography, geology and geophysics in the University of Cambridge in May 1947 and Dr Umbgrove has made a few additions to the original text in order to augment the usefulness of the book which for the rest appears as it was spoken

A glance at the map of the East Indies shows certain interesting features, the Sunda Shelf, the peculiar grouping of the Greater Sunda Islands—Borneo, Java and Sumatra with Malaya, including some smaller group of islands in the Java Sea and South China Sea and the extensive double row of volcanoes The author in the first chapter answers the question that arouses one's curiosity—how and when this pattern of islands came into being?

The shallow seas form the first topic in which the author has dealt in detail the distribution of the bottom deposits in the Java Sea which reveal some remarkable facts Some of the sediments which are rich in clastic products from the land could not possibly have originated under marine condition prevailing at the present and it is thought that Sunda Shelf was formed under subaerial conditions of weathering and river transport and became drowned afterwards —either as a result of post-glacial rise of sea-level or as a consequence of downward movement of the bottom or a combination of both The bathymetric charts have made possible the reconstruction of drowned rivers in the South China Sea and the Java Sea (text-fig 3) and paleogeography of the region is discussed in detail A bathymetric map of Sunda Straits and part of the Java Sea is given (text fig 9) and origin of sea straits discussed Morphological features of coral cays known from these areas are discussed and a schematic block diagram of a coral cay in the Bay of Batavia is also given (text fig 15)

Chapter II deals with deep sea basins and troughs in which their relation to structural history of the archipelago as a whole is discussed as well as their time of origin Influence of configuration of the deep sea basins and troughs which is of great importance to several oceanographic and geological questions is discussed Renewal of the abyssal water of Moluccas from Pacific Ocean, along three entrances, influence of oxygen content of abyssal water on character of bottom deposits and rates of sedimentation absence of red sea clay and Radiolaria ooze and remarkable distribution of Globigerina ooze and blue mud are the synopsis of subject discussed

Chapter III is devoted to volcanoes, their different types volcano tectonic structures, relation between volcanism, plutonism and tectonics and epochs of increased volcanic activity The problematic questions of why is the volcanic arc, in the double festoon, on the concave or inner side and not on the convex or outer side and why there were two distinct phases of elevation and rejuvenated magmatic phenomena in the region of the East Indian inner arc since Miocene times are answered in Chapter VI where an attempt has been made by the author to elucidate all these problematic features into a general synopsis

Chapter IV deals with structural zones which are discussed in chronological order and are illustrated among others by paleogeographic map after the Laramide epoch of compression, paleographic maps of the Eocene, Miocene (Tertiary), and Pliocene times In the Western part of the archipelago four zones seem to be particularly clear during the Cenozoic history—(a) the islands west of Sumatra belonging to a non volcanic strip, the most recent folding of which occurs in the Miocene, (b) the geanticlinal zone of Western Sumatra, Southern Java and the lesser Sunda Islands with a conspicuous girdle of volcanoes, (c) the series of idio-geosynclines, moderately folded towards the end of Pliocene and then elevated and (d) the pre-Tertiary folded area of Malaya, Banka, Billiton, the Riouw archipelago and part of Borneo including the area of the South China Sea and Java Sea and probably reaching as far as Western Celebes A synopsis of structural zones discussed in the chapter is tabulated in a simplified version (Table IV) and a synopsis of Tertiary stratigraphy is also given in the form of a text figure (text-fig 49)

Chapter V deals with the geophysical investigations which are threefold and concern terrestrial magnetism, seismology and gravity researches Seismic and gravimetric results are considered while the magnetic data is thought to be scanty

In the last Chapter Dr Umbgrove constructs a synthesis of the geological history of the East Indies and recalls the geophysical theory of Vening Meinesz Some of the subjects discussed in this Chapter were treated in part of Chapter VII, 'Island Arcs' of the second edition of *the Pulse of The Earth* by the same author

The book is richly illustrated with well chosen figures and maps and is written in a lucid style and gives a very interesting reading It will certainly be welcomed by most of geological colleagues who have been wanting to know more about the structure of a region

H S P

Colloid Science—By A E Alexander and P Johnson Vol I & II, Oxford University Press, pp XX+837 Price £ 3 net

The book is intended to be an advanced text book of Colloid Science

Colloid Science is the science of fine particles It has its own physics and chemistry though this branch of science as it stands to day is popularly known as Colloid Chemistry It owes for its development to an exact science, in no small measure to the works of physicists, mathematicians and biologists The concepts pervading the science of colloids and tools developed for its studies and mathematics invoked are being predominantly exploited by chemists The science of Colloid Physics still awaits to be developed The turbid science is essentially a fudamental science which the authors have spared no pains to emphasize

The book differs in contents and treatment from other text books of Colloid Chemistry because of simplified mathematical treatment of subject matter That a mathematical out look is indispensible for proper understanding of Colloid Science to day is very often overlooked in many text books and treatises The book is a "modern treatment of Colloid Science intermediate between the elementary and purely descriptive on the one hand, and on the other the specialised treatments in monographs and articles on recent advances' It is divided into three parts The first part deals with historical development of the science and modern views of the colloidal state, the second part on the experimenmental methods and their theoretical basis and the third part (Vol II) with the study of important Colloid systems

Treatments of each of the parts are logical and sufficiently up to date A good feature of the book is the treatment of the theories of different tools and experimental techniques adopted in Colloid Science. The authors have not left the matter after giving a bare out line of theoretical principles (which seldom helps to guess what goes on in the experiments) and a list of references The authors have dealt the science in the manner in which it has grown and the treatment is somewhat comprehensive

In dealing with a fast developing subject like Colloid Science, controversial issues cannot be avoided and the volumes contain discussion on many such For this reason at least, if not for other reasons the book could have contained profuse references to the various schools of thoughts

In the chapter on clays and zeolites (Chapter XXV) such loose statements as the following should better have been avoided *viz*,

'The phenomenon of base or ion exchange by Zeolites cannot properly be included under their *adsorptive properties*, since the process involved is purely one of exchange (P 726)

'Equilibrium in the clays is reached almost instantaneously (P 726)—which is not correct

In discussions on origin of charge (p 43 48) reference should have been made to the classical works of Mukherjee (1921) Though the idea of ion pair formation on the body of a charged colloid particle was first suggested by Mukherjee, reference has not been made to such works The authors write without reference as '– "these gegenions are bound by electrostatic forces solely (*i e.* as ion pairs on the Bjerrum's view and move kinetically with the particle "This is the conception to which Mukherjee's theory of electrical double layer leads to.

In scattered discussions on Donan membrane equilibrium reference has not been made to the important theoritical researches of Choudhury (The Donnan Membrane Equilibrium by S G Choudhury, 1945, Published by A K Bhattacharjee, Santragachi, Howrah)

The important works of Marshall and his school on artificial silicate membranes have been overlooked in discussion on membrane potentials

These and other such omissions somewhat diminishes the usefulness of the book to research workers

Lucid treatment of subject matters and many other merits of the book far outways the minor shortcomings and it can be unreservedly recommended as a text book for advanced students of Colloid Chemistry

The authors have very ably dealt with the problems of correlating physico-chemical properties of colloidal systems with their structural peculiarities The chapter on 'thermodynamics and its application to colloidal systems deserves to be specially mentioned for its clarity The question of the meaning of moelcular weights in colloidal system is very aptly raised Logically it is better to use the term" "particle mass" rather than 'molecular weights" when discussing colloidal systems, though in proteins and other light polymer systems it is customary to talk of molecular weights even though the systems are actually polydisperse

A. K G

SCIENCE AND CULTURE

A Monthly Journal of Natural and Cultural Sciences

Vol. 15 **DECEMBER 1949** **No. 6**

OUR NATURAL RESOURCES AND THEIR CONSERVATION

SOME 640 scientists representing 50 nations met in August this year at Lake Success U S A to study the various problems relating to conservation and wiser use of world's natural resources Considering the fact that the science of conservation is still in its infancy in India, the contribution made by the Indian delegation at the conference was of sufficiently high order The American delegates, however, dominated the conference and rightly so, because it was in America that the technique of conservation and utilization of resources was perfected and put to practice The American Association for the Advancement of Science was perhaps the first scientific organization to focus the attention of the world to this vital issue The Americans however, could not push on vigorously with their programme of conservation until Theodore Roosevelt became President of the U S in 1901 The forests which were disappearing very fast had to be preserved President Roosevelt succeeded in increasing forest reservation of his country to more than 116 million acres, and in withdrawing from private entry another 118 million acres of potentially rich mineral bearing land It was at his suggestion that the National Conservation Commission was founded in the country and international conferences were organised to consider this question. In more recent years President Franklin D Roosevelt was a great champion of the conservation movement It was during his administration that the famous Tennessee Valley Scheme was formulated and got going This scheme ranks as one of the spectacular examples of how a country's natural wealth can be conserved, developed and finally improved The Russian schemes of resource conservation and utilisation, as embodied in the series of Five Year Plans, are much more spectacular examples of what a nation can do in this respect, inspite of initial backwardness, if they have the will to get things done. The Soviet Union has thus been transformed from a poor and ill equipped agricultural country into a highly industrialized State within such a short time as thirty years The conservation movement is also gaining ground in countries like the United Kingdom A special Ministry of Town and Country Planning was established during the last war in Great Britain, with a view to conserving and utilizing natural resources which were neglected before

Natural resources are fundamentally environment functioning in the service of man, and their true appraisal depends upon a number of variable factors such as human wants and human abilities Forests, soils, waters, minerals and animal life are the *essential* element of environment which man exploits for his very existence Conservation is defined as the course of action which will secure for mankind at least as great a future benefit from the exploitation of environment as is now enjoyed It therefore includes the protection of the forests, the prevention of soil erosion, the proper utilization of water resources, the careful mining of minerals, and the care of animal life including the fish The conservation of the human life and culture of the nation is considered to be the most important phase of this movement Accepting the principle that every nation should now be free to its own course of action, the technique for resource conservation must be devised differently for different countries based upon the degree of political and economic independence previously enjoyed by the people All the above topics were thoroughly discussed at the Lake Success Conference, each delegation emphasing their special viewpoint

The Conservation of Man One of the fundamental resources of any nation is the skill and energy of its population Even in the richest country of the world, the United States, the net money value of all the people is found to be twice as great as that of all the country's material possessions of every description In less developed and more densely populated countries like India the *per capita* money value of man may be less, but the total money value of the entire population amounts almost to an astronomical figure and is at least fifty times greater than that of the utilisable material wealth of the country Yet man is left to his fate in India The productive years of man are, therefore, considerably shortened in India Every year 34 million children die before reaching their fifteenth birthday, costing the country several hundred crores of rupees What an enormous drain on the country's resources! What a tremendous waste of the human material, the greatest asset of India This question should, therefore, be given the first priority in any conservation programme for India, so that under nourishment and insufficient education may no longer retard the healthy growth of the Indian child

Forest, their conservation and utilization Forests constitute undoubtedly one of man's greatest and at the same time most mismanaged resources The National Planning Committee of India, therefore, did a very wise thing in appointing a sub committee on Soil Conservation and Afforestation which started its work sometime in 1939 The very first resolution adopted by this sub committee was as follows "Soils and Forests constitute a national heritage On their successful conservation depend the present and the future of the nation The State must therefore step in and accept responsibility for their conservation Originally forests covered at least one third of the surface of the earth, but due to their ruthless destruction by man, they now hardly cover 9 000 million acres, that is to say, less than one sixth over the total area of the world There are records to show that the Sahara desert was forested and inhabited in the past, and that ancient civilizations once flourished in regions of Asia and South America, are now invaded by deserts

Clearing of the land for agricultural activities has been the chief factor in forest depletion throughout the world, more so in under developed countries like India and China which contain more than one third of the entire world population In India the dense forests of the Gangetic valley had to be cleared off to give place to the plants favoured by man—wheat, rice, barley—all members of the grass family The second major factor responsible for forest depletion is lumbering on a commercial scale, as practised in the U S.A and Europe It is reported that the United States alone cuts as much lumber per year as the rest of the world together Of the other causes leading to destruction of forests mention may be made of forest fire, wind erosion, over grazing, and insect pests Forest fires may occur from both natural and human causes The major natural causes of forest fire is lightning In India such fires often do considerable damage to forests in summer months The fire protective measures devised so far need further improvement For example, the method of early burning of dry fallen leaves, grasses and decayed wood under supervision may minimize the danger of natural fire during the Nor wester months, but gives rise definitely to soil erosion which adversely affects the growth of seedlings The disappearance of forests from the Sahara and other man made deserts was caused mainly by wind erosion. The invasion of deserts into forest lands can early be prevented, if proper steps are taken Cultivation of natural grasses on land denuded of forest coverings is thought to be most effective in checking the growth of deserts Hill slopes exposed to violent winds are often devoid of any trees The Cherrapunji scarp is a classical example of forest land totally damaged by strong gales Animals grazing in forest land often do serious damage to both seedlings and older trees In India more than one crore of animals graze every year in State forests Grazing should be controlled, if forest stands are to remain productive for years The damage done to forest by insect pests is also preventible In the United States, some 387,000 acres of valuable forests were sprayed successfully in 1947 from the aeroplane against the tussock moth

Forests provide mainly fuel wood and timber for the use of man It is estimated that the world consumption of these two forest products amounts to 250 million cubic metres per year Another 250 million cubic metres is consumed annually for feeding industries like paper and rayon, and for various other purposes Even this heavy consumption falls far short of the present demand for timber and firewood in the post war world, and the natural tendency today is to fell trees indiscriminately, not knowing that this will hasten the death of the remaining valuable timber stands Coniferous soft wood forests are now exploited more rapidly than tropical or temperate hard wood forests The Soviet Union is the only country that has large reserves of conifers for export and future use Finland and the two Scandinavian countries—Norway and Sweden, are also very rich in softwood, and have exportable surplus, though consuming more wood *per capita* than any other nation of the world All the other European countries, though once heavily forested used up practically whole of their forest resources, and later adopted vigorous forest policy, which included regular planting, scientific stripcutting, complete utilization of all forest products and State ownership or control As a result of this policy, Germany had more than one quarter of her area covered with forests, and France, about one-fifth before the last world war

India is a typical example of what happens when forests are destroyed Once India had extensive and excellent forests, but now hardly 12 per cent of its area is covered with dense forests, and that too, mostly in inaccessible and mountainous areas Because of shortage of firewood in the neighbourhood of villages, villagers in India are obliged to use cowdung extensively as fuel The waste of this good and cheap manure cannot be stopped until forests around villages are restored Destruction of forests also intensified river floods in India, causing untold sufferings to the millions who lived in flood plains It is a pity that the previous Government of India did not make any use of their powers under the 'Indian Forest Act, 1927 for minimizing the evil effects of ruthless destruction of trees by owners of private forests Now that India has attained Independence, it is hoped that the forest departments in the provinces will adopt a more vigorous forest policy for the proper maintenance and utilization of existing forests, and for planting of trees in lands agriculturally unproductive

Soil and Soil Erosion The soils of a country constitute its most valuable natural resource, as it feeds the plants, which provide all the three basic needs of man,—food, clothing and shelter The soil formation is a very slow process, and it takes nature more than 1000 years to build one inch of top soil, the most vital part of the soil profile It should be realised that when this top soil, say upto the depth of 6 inches from the surface, is removed either by wind or by water or by man for repairing unmetalled roads, the most common practice in India, 6000 years of nature's work goes to waste It is estimated that the U S A loses some 400 million dollars every year because of soil erosion and consequent low productivity of agricultural land In India about one half of the agritural land is suffering from soil erosion This accounts for shortage of food for man, and fodder for domesticated animal Since soil erosion can be controlled in a practical way, an effective organisation on the lines of the Soil Erosion Service of the United States, should be established in India The examples of other countries say France or Italy can be effectively followed by India in the reclamation of deeply eroded fields for agricultural use, and in bringing again under the plough thousands of acres, now lying waste because of extremely low fertility

Water resources, and their utilization Man uses water in so many ways that he often takes it to be an unlimited resource like air, and does not take steps for its proper utilization and conservation until he is confronted with a serious water shortage In any scheme of planning for water resources development the just apportionment of water between the various users should be the guiding principle The order of importance of the various uses of water, as suggested by Throndike Saville in 1935, still holds good It is as follows (*i*) atomspheric moisture indispensable to organic life, (*ii*) drinking water for man, (*iii*) water used in agriculture and husbandry, (*iv*) water as a habitat of fish, (*v*) water used for generation of power (*vi*) water used for mechanical and chemical processes in industry, (*vii*) water as a means of transportation (*viii*) water as a medium for the removal and purification of water, (*ix*) water as a recreational asset, (*x*) water used as ice

The rainfall of India is so erratic and seasonal that too much dependance on it should be discouraged and vigorous water policy is to be pursued, as advocated by the National Planning Committee, so as to get the greatest benefit possible from the country's water resources The sub committee on River Training and Irrigation had recommended the establishment of a National Water Resources Board for the conservation and utilization of water resources in the country

Minerals and their conservation Nature has given to man her veritable treasures in the form of minerals But unfortunately these resources are not only exhaustible but are also irreplaceable This fact has been ignored so far and more minerals have been extracted from the earth in the last thirty years than in the whole of previous history As a result of such intensive exploitation, most of the rich mineral deposits are on the point of exhaustion Iron, manganese, aluminium and mercury may last for another hundred years, but some like nickel, lead zinc, gold, silver and diamonds will disappear from the mines within a generation Hence, it is natural that there should have been a lively discussion at the Lake Success Conference on the problem of techniques for conserving mineral resources It was pointed out in the meeting by representatives of under developed countries that measures adopted for conservation of mineral resources in their countries were far from satisfactory, and that their mines were denuded of rich minerals for the benefit of foreign countries According to Wadia India alone has supplied 40 million tons of manganese ores of the higher grade since 1900 at a price little above the cost of mining and transport to the consuming foreign countries It is hoped that the Bureau of Mines, recently established in India, will look into the problem, and devise means for the wiser use of minerals The Bureau of Mines should give first attention to coal and petroleum, the two chief energy producing raw materials The Industrial Revolution in Britain was made possible by the widespread distribution of the coal fields, and if in a country like Britain there could be an acute shortage of coal in recent years with the consequent disruption of industry and commerce, the same thing may happen in India in a much worse form, unless steps are taken in time to avert such a crisis In the petroleum world India's position is critical The Digboi fields contribute only a fraction of petroleum products consumed in India Because of India's deficiency in petroleum, agricultural substitutes for petroleum like alcohol from the fermentation of grain and molasses should be manufactured and extensively used The Bureau of Mines should also encourage prospecting for petroleum in different parts of the country, especially in the Himalayan foot hill zone As to non ferrous metals, the richer deposits should be conserved, and known low grade ore deposits should be opened up It may be pointed out in this connexion that with government subsidy and tariff protection worthless rocks have been converted into rich ores in countries like the United States, the Soviet Union and Germany

Preservation of Wild life including the fish The oldest occupations of man were hunting and fishing As a result, very few wild animals are found today except in very inaccessible and remote places The preservation of wild life, therefore, forms an integral part of the conservation movement Wild animals should be preserved not only for recreational and aesthetic reasons, but also because they form part of the economy of nature The drain on wild life in the forests of India has been enormous As a result no lions are known to exist in any of the forests, the solitary exception being the Gir Forest of Junagadh

Commercial fisheries are divided into fresh water, coastal and open sea types For the world as a whole the fresh water fisheries are less important than the other types, but it is just the reverse in India at the moment According to Hora pond culture is a type of animal husbandry which has its highest application in tropical countries and a lucrative industry According to Srinivasa Rao, another Indian delegate at the Lake Success Conference, exploitation rather than conservation is the immediate problem of marine fisheries in India With a large continental shelf bordering on three sides in addition to a number of river estuaries penetrating into the land, India has an ideal setting for the development of marine fisheries

---

PHYSICAL METHODS OF TESTING JUTE FIBRE

K R SEN

TECHNOLOGICAL RESEARCH LABORATORIES INDIAN CENTRAL JUTE COMMITTEE CALCUTTA

INTRODUCTION

IN order to study fibre quality in relation to the spinning performance, it is essential that the units tested as fibre and the units which compose the yarn should be the same (1) Therefore in the case of jute, as the fibre occurs in nature as a meshy complex it requires to be thoroughly broken down in course of processing Necessity is therefore felt for the development of a suitable method of filamentation which can be easily manipulated so as to produce the requisite degree of dimensional fineness of the fibre A method of separation by hand, which has been found to yield filamental entities of the same order of fineness as occurs in a yarn, has been developed and is described here

As hand manipulation methods usually must be, this method naturally suffers from the drawback of being rather time consuming Device of a suitably handy filamentation machine is therefore important

Filaments obtained by the method of hand separation from batched jute, have been tested for characters of gravimetric fineness, strength and slipperiness For the measurement of the last named character a special instrument was devised These characters are as known from experience with other fibres important factors in the determination of the behaviour of a textile fibre during processing as well as the strength and uniformity of the yarn produced

A procedure for estimating the relative splittability of the meshy jute fibre such as will allow reduction into the category of spinnable filamental units has been indicated

METHOD OF SINGLE FILAMENT PRODUCTION

For spinning jute, the greater the transverse splittability of the natural meshy fibre, the less is the degree of available complexity due to filaments of various sizes being joined together within the processed fibre, and also the better is the strength of the yarn produced The improvement in strength is mainly due to the reduction of irregularity of yarn structure During the process to which a jute fibre is treated for producing yarn the filamentation from the meshy complex is effected by the gill pin system acting under the draft So, it is clear that filamentation can only occur in those cases in which either the gill pin can penetrate in between two adhering filaments or it can arrest or obstruct the movement of one part of a joint filament while the other part is torn asunder under the pull of the drafting force *For appropriate degree of filamentation therefore we should imitate these co occurring functions of the gill pin and the applied draft*

The hand manipulation procedure developed as an interim method *i e* until a suitable machine is available for filamentation is described below in detail

Suppose a fragment F (fig 1) composed of adhering filaments of which only two are shown for the sake of simplicity is collected *at random* from the mass of fibre cut to suitable size after batching and light combing Let the fragment F possess a branch at a' and a non adherant region b In such case the bifurcated ends should be held separated from each other between the thumb and the fore finger of the left hand near the outermost points as indicated by the opposing full line arrows The plane containing the ends of the adhering filaments should, for convenience, be horizontal, and the holding pressure should therefore act vertically Then with the thumb and the fore finger of the right hand (*only the fleshy parts of the fingers should be employed*) suitably light pressure should be applied in the same direction as with the left hand The two fingers of the right hand thus concerned, must extend, at least in part, to the bifurcated region The pressing fingers of the two hands should be situated at start as near to each other respectively as possible Thereafter, beginning from a point in the plane of the bifurcated ends, where the filaments are already separated, the point of light pressure (with the right hand)

---

* Based on papers & memoirs published under the auspices of the Indian Central Jute Committee

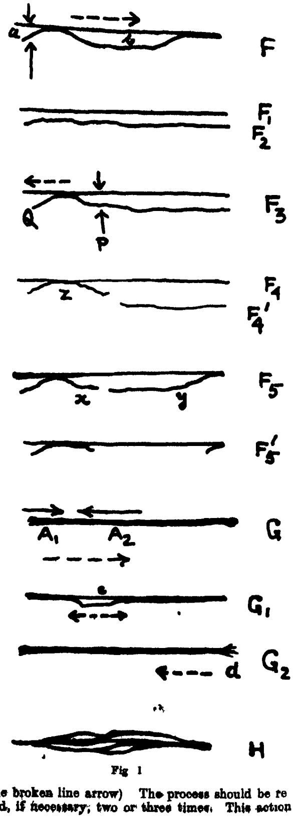


Fig 1

should be continuously slid along in the direction of the other end of the fragment concerned (as indicated by the broken line arrow) The process should be repeated, if necessary, two or three times. This action will result in either F being split over the whole length and producing the two single filaments F_1 and F_2, or showing itself as F_3

In the case of F_3 the fragment should be held fast between the thumb and the forefinger of the right hand at P or even a little farther away to the right of the diagram in the same manner as F was held by the left hand A moving light pressure with the fleshy portions of the thumb and the fore finger of the left hand should be exerted continuously from a point in the already separated region towards Q This will either split up the fragment F into two single filaments F_1 and F_2 or will tear off one of the filaments, producing two pieces like F_4 and F_4' If the portion adhering to F_4 is very small F_4 may be regarded as a single filament as also F_4' ignoring the small attachment z

In some cases F may appear at the end of the first treatment as F_5 When this happens the larger portion x may be treated like F and the smaller portion y may be pulled off If x is not separated into single filament by the action recommended it may also be pulled off leaving F_5 to assume the form F_5' This F_5' when the adherant portions are very small may be taken to represent a single filament

Sometimes one may come across a thick fragment which is composed of two or more single filaments completely adhering together at all or almost all points throughout the length of the piece Such a thick fragment is represented by G Either this fragment G does not at first show up any branching at the extremities or it shows some branches not longer than a mm (say) When no branching is at all observed the fragment may either be a composite one or a single filament of the flat ribbon type If the extremities however reveal small branches G must be regarded as consisting of perfectly ahderant filamental components When a fragment like G is met with it becomes therefore necessary to ascertain whether there are adherant filaments or not and whether if such filaments exist it is possible to easily separate them To do this two suitably separated points A_1 and A_2 should be selected on the fragment The separation of the two points should be small but not so small as to damage the fibre when the process described below is applied These two points should then be held respectively by the left and the right hands between the thumb and the fore finger of either There should be about 15 or 16 mms of free space between the pairs of fingers The two hands should then be made to appraoch each other quickly but should not be brought so close together as to bend the fragment into a permanent kink The directions of the opposite movements are indicated by the full line arrows This process should be continued over the whole length proceeding step by step as indicated by the broken line arrow

If after this treatment, even when repeated once or twice, no non adherant portion at any part should come into view, the fragment G should be classed as a single filament—either one of the flat ribbon type, or one which is composite but not easily splittable mechaniclly Often it may be found however that the fragment G, after this treatment, looks like G_1 or G_2. In each of these cases the fragment should be subjected to similar treatment as F. The treatment should begin at 'c' in the case of G_1 and proceed in either direction successively In the case of G_2 the treatment should begin at 'd' proceeding towards the other end of the fragment, as indicated by the broken line arrow

The multiple components in any fragment should, as far as possible be separated by treating in pairs If there are multiple filaments in a fragment like the one shown at H, each region of a pair of non adherant filaments should be successively dealt with as in the case of F

With regard to the process of splitting described above, the following facts may be noted The presence of non adherant or branching fibres makes it very likely that the elements joined together should be separated by the machineries The probability is especially increased when the fibre has been softened by batching On the other hand, the adherant filaments which do not show up any non adherant region, are not quite so likely to be split up into components, i e unless the fibre, batched and softened, under action of the relative frictional drag against other fibres, under the tension of the draft, as well as the vibratory effect of the machine in action, reveals any non-adherant region wherein the gill pin may enter It is undoubtedly possible therefore that in actual processing, some of the filaments which were originally totally adherant, will be split up It is also possible of course, in as much as the whole process is governed by the law of chance, that some adherant filaments with even non adhering portions showing, will escape splitting But considering the method of silver doubling and repeated drafting through gill pin systems, the number which may escape untouched will be extremely small

In the procedure described above, the treatment given to the fragment F or H, as well as the latter part of the treatment given to the fragment G, may be taken corresponding to the action of the gill pins on the fibres under draft The light pressure with which the thumb and the fore finger of the right hand try to draw apart the already partially separated filaments, the fleshy parts of the two fingers being in contact in the intervening space between the separated parts of the fragment, is like the light pressure exerted by the relative motion of the fibre under draft against the penetrating body of the gill pin The diagramatic representation can be seen in Fig 2 The first part of the treatment given to the fragment G, corresponds to the softening treatment subsequent to batching, as well as the separating action of the vibrating machinery

This close analogy between the treatment given in processing and that given in the procedure described above with regard to the principle of action, makes it safe to conclude that the constituents of a fragment with adherant filaments, which have not been separated under the above manipulatory treatment will not be likely to be separated by the machinery; and that most of the filaments secured by the hand-treatment, will be likely to be produced in actual processing also The technique of filamentation described, will thus be most likely to make the jute fibre practically assume the same order of fineness as obtains in spinning The similarity of the order of fineness can be seen from actual data reproduced here

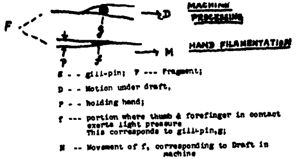

F
D
M
g
p
f
MACHINE PROCESSING
HAND FILAMENTATION
g - - gill-pin; F --- Fragment;
D - - Motion under draft,
p - - holding hand;
f --- portion where thumb & forefinger in contact exerts light pressure This corresponds to gill-pin,g;
M -- Movement of f, corresponding to Draft in machine

Fig 2

TABLE I

Jute	Quality	Filament mass per unit length (micro gm /cm)		
Variety	Grade	Hand separated (A)	From standard Yarn (B)	Difference (A B)
White	Low	37 ± 2 6	31 ± 1 8	6 ± 3 2
White	Medium	23 ± 0 9	25 ± 0 5	−2 ± 1 2
White	Fine	26 ± 0 4	29 ± —*	− 3 ± —
Tossa	Fine I	25 ± 0 4	29 ± 0 3	−4 ± 0 5
Tossa	Fine II	22 ± 0 2	24 ± 0 5	−2 ± 0 5
Tossa	Superfine	24 ± 0 7	27 ± 1 0	−3 ± 1 2

*This was found by sorter method from values for different length groups

TESTING FOR QUALITY

(a) *Staple length of Filament* The fibre elements in raw jute are several feet long and connected together in the form of a meshy complex Longitudinal break down naturally accompanies transverse reduction of size in course of processing So, the staple length of the spun elements of jute is only a *post facto* determinable quantity

The filaments unravelled from a yarn are crimped due to the pressure of the twists applied in spinning The crimps formed in the yarn-filaments in that manner no doubt serve a useful purpose by creating an unevenness on the surface of a filament, which largely augments the resistance to mutual slip and also prevents twists from running out However, due to these artificially generated crimps in the filaments drawn from an untwisted yarn, these filaments are not amenable to accurate testing by an ordinary sorter of the Baer-type used for cotton

Some results obtained by direct measurement, against a suitable scale, of large number of filaments constituting all the tractable ones from several portions of a standard yarn are stated below

TABLE II

Mean Group Length	Relative Frequency (%)					
	White Jute			Tossa Jute		
	A	B	C*	A	B	C
(cm)						
1 0	0 1	—	0 3		0 4	0 2
4 0	2 1	0 1	4 0	0 1	7 0	3 7
7 0	22 6	7 4	10 0	1 4	21 7	23 9
10 0	33 6	38 6	23 0	24 6	24 4	30 8
13 0	22 8	26 0	24 0	34 6	21 1	20 0
16 0	12 2	16 2	16 7	22 4	13 2	12 2
19 0	4 6	8 2	12 5	11 4	6 8	5 9
22 0	1 6	2 3	6 0	4 0	4 0	1 9
25 0	0 3	1 0	3 5	1 2	1 1	0 9
28 0	0 1	0 1		0 3	0 3	0 3
31 0	—	0 1		—		0 0
34 0	—			—	—	0 0
37 0		—		—	—	0 1
40 0						0 0
43 0				—		0 1
Mean Length (cm)	11 3 ±0 19	12 7 ±0 11	13 5 ±0 38	14 1 ±0 11	11 6 ±0 12	11 4 ±0 13
No of filaments examd	1015	1199	1270	1166	946	1134

* Tested by the sorter technique which was later discontinued due to roughness of accuracy Data reduced to scale from smoothed graph

It can be seen from these data that the length distribution of jute filaments composing a yarn is negatively skew indicating thereby a *bias* in favour of short lengths Remembering the fact that the length as such is generated by the machines by frequently breaking down the very much longer elements and the medium and the shorter lengths only on relatively rare occasions in the course of processing the existence of such *bias* is easily understood The effect is in some respects similar to the one discussed previously in the case of ginning of cotton (2) The distribution in the case of cotton where fibre length mostly depends on the biological growth conditions should basically be symmetrical according to the Gaussian exponential law Of course due to the environmental causes particularly those of systematic decline of temperature and the mechanical treatment such as ginning a small *bias* may be introduced on account of premature cessation of growth or breakage of longer units This produces a small negative skewness in the length distribution of cotton

(*b*) *Gravimetric Fineness of Filament* —The gravimetric fineness expressed as mass per unit length was done on 10 test samples of batched jute combed previously with a specified number of drawings (25/30) over 4 rows of gill pins from the hessian roving frame Combing actually removes some of the finer constituents (6) from the sample But the change when single filaments are under test, may be considered as being very small The test samples were obtained from the stock of combed fibre by the method of repeated subdivision and subsequent picking up of small quantities from the sub group samples Filamentation was carried out by hand according to the technique described The results have been stated under A in Table I Also from the total weight and number of filaments whose length distribution is given in Table II the gravimetric fineness of filaments composing the yarn was obtained The data for the yarn filaments are given under B in Table I

From the values noted in Table I it is seen that the fineness of hand separated filaments was generally lower than that of the yarn filaments The difference was sometimes non significant also The relative nature of difference is understood if we remember the following probable cases —

(*i*) Some fibre entities may remain incompletely reduced into single filaments during processing wherein the whole thing is controlled by the law of chance according to the disposition of the fibres at start and in relation to their physical characters and

(*ii*) somewhat under estimation of length of the yarn filaments concerned is possible on account of the crimps present (In some cases crimps defied any moderate attempt at straightening without possible break up of the complex structure)

The positive difference in one of the cases observed can be easily understood if it is remembered that the sampling effect in the case of this low quality white jute was very large as the largest value of the standard error for the same number of observations as for others indicate (In this case hand filamentation was also very difficult to carry out fully due to powerful and often extensive adhesion of individuals)

The reliability of the hand separating method of filamentation can be judged from (*i*) the very low standard error for 10 observations (*ii*) the attainment of the same order of smallness which the actual yarn filaments exhibit and (*iii*) the very exact reproducibility which different workers using the same complex fibre bulk for drawing the respective lot of 10 samples reach The reproducibility may be judged from Table III below

The fine quality variety of white jute which was tested by the Baer type sorter (as used for cotton) provided but roughly with various length groups The sorter used consisted of 48 rows of 24 gill stocks from the hessian roving frame each row consisting of 11 pins A suitable metal block with normally situated parallel metal plates was used to press down the fibres laid out on the combs so as to form a compact lot having a common end line By removing combs gradually different groups of fibres were collected These were then checked for length against the corresponding mean group length, counted and weighed During checking the length, the displaced filaments were redistributed as far as possible over the relevant groups The mass per unit length values obtained for the different length groups were plotted against corresponding mean lengths in Fig 3 This figure provides us clearly with an indication that the longer the filamentous constituent of a jute yarn, generally the coarser it is

TABLE III

Jute	Order of testing	Tester	Gravimetric Fineness (microgm/cm)	Maximum Difference between two Testers Values (microgm/cm)	2 X s e of Difference
White fine	I	A	26 4 ± 0 36	0 4	0 81
	II	B	26 0 ± 0 19		
	III	C	26 8 ± 0 30		
Tossa fine A	I	A	21 9 ± 0 23	0 4	0 66
	II	D	21 9 ± 0 14		
	III	C	21 5 ± 0 30		
Tossa fine-B	I	A	25 1 ± 0 38	0 5	0 81
	II	C	25 4 ± 0 20		
	III	F*			
	IV	F	14 10 ± 35		

*in parts

the successive slips were noted starting after the first one The first slip was considered to mark the zero position of tension on the slipping filament Test was carried on 100 filaments for each jute (in the case of one fine tossa fibre the number available was 93) The results are given in Table V

In the measurement of the frictional resistance of jute the greatest amount of difficulty lay in the making of uniform pads in which the fibres were arranged in a parallel, and also sufficiently compact, pattern Without uniformity, the contact between the slipping and the pad fibres is likely to become uncertain Also, lack of compactness makes the normal pressure indefinite The difficulty in pad-forming is greatly aggravated by the stiffness of the jute fibre as well as the hairy appearance of surface rendered by the short elements joined to the full-length ones.

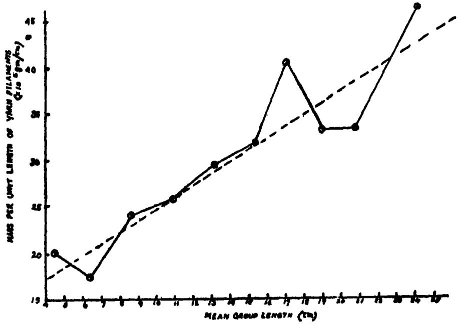


Fig 3

(c) *Frictional Resistance of Filaments* The instrument used for this purpose is shown in Fig 4 The description of the parts is stated underneath the diagram The tension on the filament which was made to slip against two mutually pressing pads of parallel fibre, was applied by the O'neill method(3) A fixed load of 292 gms was used on the pan for the purpose of developing a suitable normal pressure between the pads The pads were 5 cms. in length Generally

After preparation, the pads, however formed require to be kept for a long time (over night) *in situ* on the instrument, in mutual contact under considerable pressure In this way the fibres in the pad may be got set into a fixed position

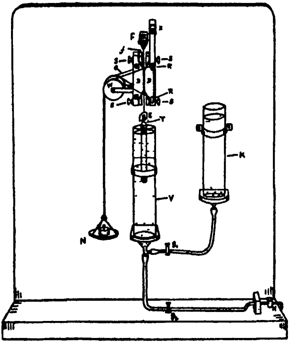


Fig 4 Filament Friction Testing Apparatus

F = Hinged forcep for placing the filaments about a fixed position relative to the pads

f = Slipping filament attached to eylet E

D = Pad blocks of which one is hanging freely about the support X and the other is fixed

S = Arrangement to hold pad fibres in position

W = 2 pully wheels over which the cords C passing round the circular rods R on each side respectively passes W is attached to the fixed pad

N = A pan for adding loads for developing a pressure between the pads hanging vertically by means of a cord tied to the Cords C brought together

T = Float and V = The cylinder for application of load

K = A reservoir for replenishing the water drawn out g_1, g_2 = regulating pinch cocks H stop cock for ON and OFF switching of flow measured by a measuring cylinder

the case of jute, the natural resistance to slip is likely to be somewhat reduced by the action of the adsorbed moisture and oil (4) which form the primary ingredients of a batching emulsion The frictional resistance which a jute filament may experience in sliding amongst others under draft during yarn formation, may contribute to yarn irregularity by means of three pronged action These are—

(i) the frictional resistance of the single filaments of a variety,

(ii) the number as well as the length of the branches of a multiple filament individual, and

(iii) the proportion of the multiple filament individuals in the material under draft

All these factors may act independently or together

(*d*) *Standard Complexity of Filament* This quantity may be defined as the ratio which the excess of the steady fragment fineness under a special combing system, over the filament fineness, bears to the latter When splitting is complete, the excess is *nil* and the complexity vanishes As the fibres become more and more difficultly splittable under the specified combing, the units are liable to remain more complex As the complexity thus increases the value of difference between the fragment mass per unit length and the filament mass per unit length increases With this, the described measure of complexity also increases

To obtain the standard condition of combing such as will lead to a steady value of fragment mass per unit length, it is necessary to reach a state in which further combing on the same set of gill blocks does not materially alter the value of fragment mass per unit length To find this state generally the varieties of jute in the batched condition were subjected to a process of progressive combing with five draws over either end each time The combs consisted of 4 rows of gill stocks from the hessian roving frame The results obtained given below show that a minimum of 20 draws over either end, gives a suitably steady value

The values of complexity calculated as above, are given in Table V

TABLE IV

Draws (Either end)	Mean Fragment mass per unit Length (microgm/cm)					
	Fine White	Superfine Tossa	Medium White	Fine Tossa (A)	Low Quality White	Fine Tossa (B)
5	129	74	80	79	196	79
10	68	53	59	51	124	52
15	53	45	48	43	99	45
20	47	44	44	38	92	41
25	47	41	41	38	95	40

It was pointed out (5) from observations on cotton and staple fibre, that yarn regularity was largely controlled by the frictional character of the fibre In

(*e*) *Strength of Filaments* The breaking strength of single filaments was found on the Baer Automatic Single Fibre Strength Tester The test length used was 10 cms For each value, 300 single filaments were examined The time of full traverse of filament-free lower clamp was maintained at 47 seconds approximately The results are noted in Table V filament lengths and their distributions are concerned The length distribution of the filaments in a yarn is moderately skew and possesses a considerably wide range

TABLE V

Filament Character	Source of Filament	Mean value for the Jute Varieties					
		Low Quality White	Medium White	Fine White	Fine Tossa-A	Fine Tossa B	Superfine Tossa
(1) Staple Length (cm)	Yarn	11 3 ± 0 19	12 7 ± 0 11	13 3 ± 0 38*	11 4 ± 0 13	14 1 ± 0 11	11 6 ± 0 12
(2) Fineness (microgm/cm)	Fibre	37 4 ± 2 58	23 3 ± 0 85	26 4 ± 0 36	21 9 ± 0 23	25 1 ± 0 38	24 1 ± 0 72
(3) Breaking Load (gm)	Fibre	63 2 ± 2 66 R H 74%	44 0 ± 1 67 R F 83%	50 8 ± 1 78 R H 72%	47 8 ± 1 63 R H 76%	60 9 ± 2 04 R.H 79%	63 5 ± 2 38 R H 77%
(4) Resistance to Slip (1/10 gm)	Fibre	8 6 ± 0 47 R H 74%	11 7 ± 0 69 R H 72%	11 2 ± 0 81 R H 72%	13 1 ± 0 58 R H 75%	8 9 ± 0 48 R.H 74%	14 0 ± 0 72 R H 74%
(5) Complexity (calc)	Fibre	1 49	0 91	0 81	0 73	0 64	0 83
(6) Tenacity (10^4) or B Load/Fineness	Fibre	16 9	18 9	19 2	21 8	24 3	26 3

*Calculation of s e is approximate for the actual length classes were somewhat unequal due to constructional defect of the improvised sorter used in this case

CONCLUDING REMARKS

(1) It is possible, by special manipulative treatment with hands, to so resolve the meshy jute as to yield single filaments of the same order of fineness as the components of a yarn

(2) Different qualities of jute react differently to the processing treatment so far as the filament lengths and their distributions are concerned The length distribution of the filaments in a yarn is moderately skew and possesses a considerably wide range

(3) White jute seems to be often coarser gravimetrically than tossa fibre, but white jute as fine as tossa is also found

(4) The filaments of a yarn when separated into length groups exhibit an increasing gravimetric coarseness with increasing length

---

COLLOIDAL GRAPHITE—A NEW LUBRICANT

K K MAJUMDAR

INDIAN SCHOOL OF MINES DHANBAD

THE usefulness of graphite as a lubricant, specially in the colloidal form is well known in all industrially advanced countries During the World War I, the Council of Scientific and Industrial Research of India, thought it worthwhile to investigate into the possibilities of purifying Indian Graphite which usually contains a large amount of impurities, to specifications suitable for direct use as solid lubricant and also for the preparation of colloidal graphite from the purified product Although these investigations which were carried out by an eminent scientist at the Indian Institute of Science, Bangalore, were successful, no attempt was made to produce the lubricant in large scale in this country and also to educate the mass about the advantages of this new lubricant

At the present time, when there is acute shortage of petroleum products, it is thought worthwhile to find out the merits of graphite as a lubricant

The lubricating property of graphite is well known for a fairly long time, but the reason was not understood, till recently, when X ray study by a number of workers[1], revealed its structure It is now well known that 'Crystal of graphite is made up of carbon atoms arranged in sheets which are parallel to and equidistant from one another Each sheet or plane might be represented as a hexagonal net work, wherein carbon atoms are situated at the points or corners of the hexagons, which in alternate planes are directly above one another These in adjacent planes are so arranged that lines projected through the hexagon centres of one plane pass through atoms in the planes immediately above and below In each of the planes the carbon atoms are in close proximity and exhibit pronounced affinity for one another, but the attraction between the planes, because of the degree to which they are isolated, is exceedingly slight This distribution of forces makes easy the sliding or separation of the planes, thus accounting for the unusual lubricating qualities of graphite "

One of the causes of friction usually met with in machineries is due to uneven surfaces of the bearings etc even after careful machining, so that during sliding, the projected portions of opposite members tend to shear off, till the surface is really smooth Another important cause of friction is due to unbalanced forces of the surface atoms These secondary valence forces, are sufficiently powerful to bring about seizure between clean surfaces[2] Graphite reduces friction not only by filling in the cavities of the machined surfaces so that the latter becomes smooth, graphite also is capable of lowering the secondary valence forces of the metallic surfaces when it is deposited on the bearing surfaces in the form of very fine state either as such or in admixture with a volatile medium which is subsequently removed, by forming a tenaceous film on the metallic surfaces

It has been found that static coefficient of friction of such surfaces is about 0 16 Fogg and Hunwicks[3] obtained a value of 0 125 using steel against surface coated with graphite, whereas with clean metal surfaces, they found that the value increased to 0 58 The Kinetic coefficient of friction of mild steel on the above surface has been found by Hughes and Whittingham[4] to be 0 09 If the graphite film is first polished with a soft cloth to orient the crystallite so that their cleavage planes are parallel to the surface the same value decreases to 0 065 Under similar conditions the same value for mild steel on mild steel was 0 35 It has been pointed out by the investigators that the Kinetic co-efficient of friction on graphited surface is lower than what could be obtained with any other substance except oily lubricants

Inspite of the beneficial effect of graphite powder its use is limited due to difficulty in application and retention on the bearing surfaces In admixture with grease, it is quite suitable for application but is limited to the restricted use of grease itself Grease is usually used where the motion of the moving part is slow or intermittent and also the load is heavy

Therefore, an ideal vehicle for graphite would be the lubricating oils, but the higher sp gravity of graphite (above 2 00) makes it difficult to keep it in suspension However, the problem has been solved by Acheson, who reduced graphite to colloidal state and dispersed it in petroleum oils, and stabilized it with suitable stabilizers Since Acheson's pioneering work, a number of methods have been reported for preparation of colloidal graphite Originally, it was prepared from artificial graphite in U S A , but subsequently in Germany, it was produced from natural graphite The particle size of the colloids in oil have been measured by Fruendlich[5] who has reported that sub-microns (500 $\mu\mu$) were present in abundance but rarely any particle of size larger than 6μ The colloidal graphite in oil is very stable

The importance of colloidal graphite as a lubricant has been proved by many workers in laboratory and field tests Mabery[6] has shown that oil containing colloidal graphite is more effective than oil alone Other workers[7] have also confirmed this view although opinion differs as to the actual amount of reduction in friction It has also been noted by some workers that when colloidal graphite is used, the machine will run efficiently for many hours even if the supply of oil is cut off

Although graphite is not regarded as an extreme pressure lubricant, it provides protection under circumstances which bring about the failure of plain lubricants Tests made on the Daimler Lanchester Worm Gear Testing Machine at National Physical Laboratory, Teddington, show that straight mineral oils, when subjected to heavy loads, lose their lubricating ability above a certain critical temperature The addition of colloidal graphite to the oils, it is interesting to note, raises the critical temperature to 10 20° Under the condition of these tests, Hyde[8] found that colloidal graphite had the effect of rendering an inferior oil the equivalent to a superior one Other tests carried out in this laboratory indicate that on devices where the oil supply can be controlled, the addition of graphite will enable the feed of lubricant to be reduced to about one third of its normal value Newbury[9] has advocated the use of colloidal graphite as lubricant for high speed tool drives, showing that it has no tendency to cake Ritter[10] has shown that, in lubricating various types of heavy machinery, a saving of not less than 20% of oil and a raising of the decomposition temperature of the oil by about 15° can be effected by adding colloidal graphite to the lubricant The addition which is 1 2 percent on starting the machinery is reduced in stages to 0 2 1 per cent and finally to 0 04 to 0 1 percent Refined anthracene oils containing about 10 percent of graphite have been successfully used as cutting oils

Migurski[11] has stated that co efficient of friction of graphited surface is 66 percent of that of oil The decrease corresponds to increase of power and economy of fuel Karplus[12] has reported that co-efficient of friction between steel and babbit metal is 0 515 but when colloidal graphite is used it is lowered to 0 140 He has also shown that when a graphoid' surface is built up due to prolonged use of colloidal graphite, much thinner layers of oil can exist on such surfaces than on a metal The result is that at higher pressures, thinner oils and a smaller quantity of oil of inferior grade may be used Several bearings were tested on a Riehle machine A normal motor oil ran hot at 7 03 kg/cm^2, but it ran cool when graphite was added to the same oil Finally, with 0 25 percent of colloidal graphite, the load was increased to 12 66 kg/cm^2 Schida[13] stated that when colloidal graphite is used for lubrication of motor cycle engine, a thin deposit of graphite is formed on the cylinder walls which gives protection from excessive wear for a limited period There is also a saving of oils It has also been stated by another worker[14] that in a given time, oil covers seven times as much surface when the metal is covered with graphite as when it is not so covered According to Matthews[15] lubricating property of an oil depends on its property to wet metal surfaces Wettability of an oil can be increased by the addition of graphite to the lubricant According to Higinbotham[16] wear tests on large fleets of motor vehicles show marked decrease where colloidal graphite is added to gasolene and lubricating oil It has also been reported that colloidal graphite gives excellent results on heavy duty bearings (heavy pumping engines etc) with simultaneous and appreciable reduction in consumption of oil and there is no flocculation of graphite

Colloidal graphite has been found specially valuable for automobile lubrication[17] Acheson, with a Panhard four cylinder car, found that 0 35 per cent of colloidal graphite added to the cylinder oil reduced the consumption of oil from 1 gallon per 200 miles to 1 gallon per 750 miles The graphite film formed on the piston rings and inside surface of the cylinders is said to produce such a perfect fit that the compression is increased No oil was carried into the exhaust, and there was no smoking Burstall reports having obtained very good results with oildag on a 20 h p Crossley gas engine at Birmingham University, which works on either suction gas or Mond gas No trouble had been experienced from hot bearings, there was not the least sign of deposit on the cylinder and the measurements frequently taken on this engine for determining mechanical efficiency showed the friction to be very low The oil consumption was also very low Moreover, colloidal graphite can be used advantageously for lubrication of machinery, exposed to high temperature specially in glass industry [18]

Another way of measuring the lubricating value of an oil is by the heat of absorption of the oil on the metal surface Oil containing colloidal graphite has a higher heat of absorption than oil without colloidal graphité[19] Less oil is therefore necessary for efficient lubrication

The excellent results obtained as mentioned above, have been due to the formation of "graphitoid" surfaces on the metal due to prolonged use of colloidal graphite along with oil or grease Graphitoid surface not only satisfies the secondary valence forces of the surface atoms of the metals and thus reduces friction, but also, because of low interfacial tension between it and lubricating oil, such surface helps spreading of oil and retards oil film rupture under difficult conditions of lubrication

The existence of graphitoid surfaces has been proved by Jenkins[20] using electron-diffraction camera In 1935, Finch, Quarrell & Wilman[21] examined the layers of graphite formed on metal surfaces and confirmed that graphite crystals were highly orientated with the cleavage slip plane parallel to the support Finch and Whitmore[22] have shown that, during the formation of the Bielby layer, the graphite is kneaded into the plastic metal, thus becoming entrapped in the amorphous surface of the bearings

In 1937 Trillat[23], while making X-ray diffraction studies in connection with lubrication phenomena found that a metallic surface which had been in contact with oildag for approximately a month yielded a pattern characteristic of graphite, This observation, in addition to verifying the results previously obtained in England with the electron-diffraction camera, proved that graphite could be directly absorbed by metals without mechanical aid

Metthews and Wolf[24] proved the presence of adsorbed graphite by micro-chemical analysis of low carbon steel shaft

Uptil now, the use of colloidal graphite has been limited to the following —

(1) for running in new engines,

(2) for diesel and gasolene engines,

(3) for bearings running at a very high temperature, where the viscosity of the oil would be reduced below a useful level and many oils would be charged,

(4) for food and chemical plants, and

(5) for mechanisms, (*a*) which must function without failure, (*b*) are frequently neglected, and (*c*) have no provision for the admission of lubricants *e g*, fire alarm boxes, automatic telephones, radio sets, clock mechanism, locks etc

The use of colloidal graphite in oil has been discussed so far Colloidal graphite in water has also played a very important part as a lubricant in steam cylinder and valves, when condensed steam, being free from oil, could be used without any purification, in wire drawing of metal filaments like molybdenum and tungsten, in which case it is the only lubricant available

Although under normal conditions, the use of colloidal graphite or graphite powder may not be econocal, it is high time that attention should be drawn as to feasibility of using these lubricants in admixture with grease or oil It may be pointed out that about 2-3 percent or less of graphite is used in graphited grease, whereas less than 1 percent of colloidal graphite in oil is incorporated in lubricating oils, the quantity being gradually reduced to 0 25 percent or even to maintain the graphitoid film that develops slowly

REFERENCES

[1] Debye and Scherrer, *Physik Z*, *18* 291 301, 1917;

Hull, *Phy Rev*, *20*, 113, 1922,

Bernal, *Proc Roy Soc* (London) *106A*, 749 73, 1924,

Hassel and Mark, *Physik Z*, *25*, 317 37, 1924,

H Ott, *Ann Physik*, *85*, 81 109, 1928.

[2] N K Adam, *Proc Inst Mech. Engrs* (Lond), *2*, 200 13, 1927

[3] Fogg and Hunwicks, *J Inst. Petroleum*, *26*, 1-18, 1940.

[4] Huges and Whittingham, *Trans Faraday Soc*, *38*, 9-27, 1942.

[5] H Fruendlich, *Chem. Zeit*, *40*, 358-359, 1916

[6] Mabery, *Ind & Eng. Chem.* *5*, 717-23, 1913.

Saytzeff *Z Ver deut Ing 58* 1174 77 1914;
Koethen *Ind & Eng Chem 18* 497 1926,
Walger and Schroeter *Petroleum Z 30* 2 4 1924
J H Hyde Report of Lubricants & Lubrication Inq irv Comm D S I.R (Lond) 75 9 1920
R C Newbury *Iron Age 149* (No 10) 44 6 1942
F Ritter *Teer and Bitumen 40* 131 2 1942
Migurski *Ind & Eng Chem* News Ed t on *12* 376 1934
H. Karplus *Z Maschinenbau 5* 1122 8 1928.
E Schida, *Automobiltech Z 36* 527 31 1933
American Chem Abs 29 8 306
Matthews, *Colliery Eng 13* 208 9 1936
H Higinbotham *Inst Mech Engrs* Lub discussions Oct. 1937 Group II 89 95 (A C A 32, 6042)
L Archbutt and R Deeley *Lubricat on & Lubricants*, pp 185 1927
V Ctyroky et al *Chem Zentr 2* 651 1941
Alexander *Colloid Chem 3* 552
Jenkins, *Ph l Mag* (7) *17* 457 66 1934
Finch Quarrell and W lman *Trans Faraday Soc 31* 1051 80 1935
Finch and Whitmore *Engineering 146* 91 1938
Trillat, and Alexander *Colloid Chem 6* pp 441
Matthews and Wolf Alexander *Collo l Chem 6* 441

RIVAL TO THE VACUUM TUBE

J SHARMA
DEPARTMENT OF PHYSICS UNIVERSITY COLLEGE OF SCIENCE CALCUTTA

FOR nearly forty years the vacuum tube even in an isolated application has brooked no rival Its standard of efficiency was too high to be aspired by any competitor Smartness in performances had given it the eagle portion and it well deserved that It was during World War II that the vacuum tube was for the first time ousted right in its primary role of rectification by a crystal rectifier In microwave radar the crystal rectifier became indispensable and replaced the vacuum tube for more than one functions In fact the wartime developement of silicon and germanium crystal rectifiers has now become as important as that of the magnetron or the klystron

The development of crystal rectifiers arose out of the need for a high gain receiver in connection with the reception of microwave radar echoes in which the limit of sensitivity was determined by the masking of the signal due to the noise in receiver circuits A receiver was therefore desired that could give high sensitivity but minimum noise in the input circuit High sensitivity could only be obtained by using super heterodyne reception But at microwave frequencies (3000 30 000 mc/sec) the mixer tubes* however modified produced large amount of noise which again increased with increasing frequency This difficulty suggested the use of crystal rectifiers as mixers and it was immediately greeted with success as they produced far less noise This success stimulated an extensive research in this line which yielded before long a number of useful rectifiers of different applications

The rectifying property of a typical crystal is shown in Fig 1 Fig 2 shows the characteristic curves in the forward direction of several typical crystals as compared to a diode It is to be noted that the break in the crystal curve is much more pronounced than that for a vacuum tube and the forward conductance at about 0 5 volt or so is much larger The back resistance for small voltages varies from 10 000 1 000 000 ohms for different rectifiers

The crystal rectifiers have been used as video detectors of microwave pulses as mixers in super het reception and as simple diodes Besides these uses the crystals have been widely used as probes and monitors in microwave power Among the special types High Burnout and High inverse voltage units are worth mentioning The former can handle large amount of power without impairing performance The latter consisting of germanium crystal can withstand back potentials as high as 100 volts yet the forward conductance even in the region of one volt is quite high

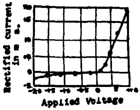


Fig 1 Typical characteristic curve of a silicon rectifier

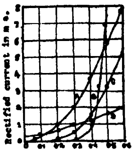


Fig 2 Characteristic curves in forward for different crystals A silicon B Germanium welded contact C Germanium high inverse voltage crystal D 6 AL 54 Vacuum tube

More recent researches have led to the development of crystal amplifiers amplification factor 100 having been already achieved This is a promising feature for it makes possible the construction of a super-het radio receiver without using a single vacuum tube This performance of the crystal has also made it an all round rival of the electronic valve

---

* Westing house 708A British CV58

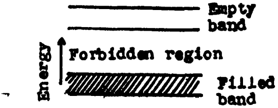
Naturally one is reminded of galena and cuprous oxide rectifiers that were used prior to the invention of the vacuum tube The present crystals are not basically different from the obsolete cousins, but they are more reliable and faithful having no future need of adjustments

The unit, in general, consists of a small silicon or germanium crystal mounted on a metallic stud, while a tungsten cat whisker in the form of a coil makes hard contact on the other side The whole assembly is fitted in a small ceramic cartridge not bigger than a half watt resistor

The development of the crystal proper has been a feat of solid physics, to which have contributed some of the best workers in solid physics, including Drs Shockley North Bardeen and Brattain The problem was studied from many angles, and it has been found that semi conductors silicon and germanium give best results when these have impurities like Al, B, Be, and N, P, Sb in the order of 0 001 per cent The impurity effect was exhaustively studied and almost all the elements (except alkali metals and a few rare earths) were tried Besides the preparation of ordinary rectifiers, it was found that 0 001 per cent of B and Be in silicon gave the high burn out crystals while Sn in germanium yielded the notable high inverse voltage rectifiers

It is evident that since such small traces of impurities are effective, the germanium and silicon crystals as such must be absolutely purified from inherent impurities When these metals having habitually trace impurities are perfectly purified (spectroscopically 99 9%), the doping materials are added in requisite amounts The job is very difficult for a stray contamination, even in microscopic amount, might spoil the whole performance Therefore the melting and recrystallization is carried out in vacuum, using in general, induction furnaces The whiskers also have to be made very carefully - particularly, the adjustment of the contact point requires great attention In amplifying crystals, two whiskers have to be fitted electrically isolated, but only 0 005 cm apart one of them working as a grid for input pulses while the other serves as the collector of the output current

Silicon and germanium belong to the group of semi conductors of a particular type Their nature and behaviour may be best understood in terms of the band theory of solids In spectroscopy, the energy levels of an atom help a lot to understand the processes so also, in solid physics the energy bands considerably help us in forming a picture of the phenomena and in interpreting the results The energy bands of a lattice are closely connected with the electronic levels of the constituent atoms, and in some cases the former can be derived from the latter[*] It will suffice to mention here that in the lattice there are a number of allowed values of energy, accessible to an electron The energy states are grouped into bands, consisting of a large number of closely spaced energy levels The number of levels of a band is, in fact, of the order of N, the number of atoms in the lattice By the exclusion principle, one individual level in the band can accomodate only one electron, so a band will have, when filled, as many electrons as there are levels in it The allowed bands are separated by ranges of energy containing no levels and therefore not permitted to electrons (Fig 3) Bands of higher energy, derived from the levels of the valence electrons of the atoms, are comparatively broad and close In a metal the valence band is partly empty, so that there exist permitted unoccupied levels adjacent to the highest filled level When an electric field is applied, the electrons in highest levels jump, to the empty levels, leading to exchange of energy with the field and causing conduction to begin In the case of an insulator, the valence electrons completely fill the band, and there is a region of forbidden levels above, so conduction cannot take place unless there is a field of 10^6 volts/cm The solid is then called an insulator



Fig, 3 Energy bands of an insulator

Semi conductors have a state of affairs somewhat midway between the two cases cited We have in fact two types of semi conductors, intrinsic and extrinsic As the names suggest, when the specimen as such in pure state is a semi conductor, it is said to be intrinsic when added impurities produce this property, it is termed extrinsic In intrinsic semi conductors the energy difference between the highest filled band and the lowest empty band is small At absolute zero it is an insulator but at higher temperatures thermal energy can pull out electrons into the conduction band when conduction begins

Silicon and germanium no doubt exhibit intrinsic semi conduction but the property is too weak to be of any use Extrinsic semiconduction occurs due to the presence of extra energy levels created by lattice defects or by the presence of impurities These extra levels (see Fig 4) act as donators or acceptors

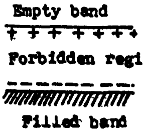


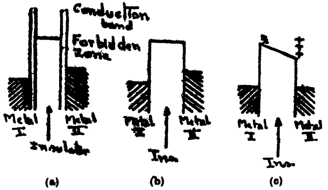
Fig 4 Band structure of an extrinsic semiconductor showing positions of donator (+) and acceptor (−) levels

and lie very close to the allowed zone A donator level is initially filled at absolute zero but at a finite temperature it can give an electron to an empty band and so can produce conduction This type of conduction is shown in germanium with Al, B, Ga impurities and is known as *n*-type semiconduction An acceptor level is empty at absolute zero but at higher temperatures it can accept an electron thereby leaving a vacancy in the filled band This vacancy in an otherwise complete band is termed 'positive hole It conducts behaving exactly like an electron but having positive charge This sort of conduction is called *p*-type and is shown by Si with N, P, Sb impurities Here the hole serves as the positive carrier of charge In either type of semiconduction the carriers of charge obey classical Maxwell Boltzmann statistics

---

[*] 'The Modern Theory of Solids by F Seitz

The principal factor responsible for rectification is the formation of a barrier layer at the contact point It is produced due to the difference in contact potentials The crossing of this barrier by the metal electrons, having exponential energy distribution, produces non linearity and results in rectification Thus rectification is the result of asymmetrical distortion of 'hump' by the applied voltage The formation of barrier layer is illustrated in Fig 5 Fig 5(a) gives the state of affairs when two metals of different work functions are widely separated (Metal 2 has lower work function) When the metals are brought together with an insulator in between, the difference of potentials (Fig 5 b) produces accumulation of charge on the insulator and the barrier is created (Fig 5c) If now voltages smaller than the difference of work functions are applied in opposite directions (Fig 6), the height of the barrier from metal 2 changes linearly, but the height from metal 1 does not change in either case Therefore, in no case will the number of electrons going from metal 1 to metal 2 be affected, whereas the flow from metal 2 to metal 1 will vary with voltages If the energy distribution of electrons above Fermi level in the metal were constant, the current would have been linear and so no rectification could be possible (4) As mentioned before, the distribution is nearly exponential and so the current becomes non-linear and rectification is exhibited Current for condition of Fig 6a will be greater and this direction of applied voltages is called forward direction For opposite voltages the resistance offered is great In brief, it can be said that the body potential differences create and maintain a barrier consisting of a swarm of electrons in the semiconductor at the point of contact This swarm produces asymmetry needed for rectification



(a) (b) (c)

Fig 5 Formation of rectifying barrier between two metals of different work function having an insulator between, (a) shows the condition when all are separate, (b) shows the difference that exists on just bringing them in contact and (c) shows the resulting accumulation of charge and formation of barrier

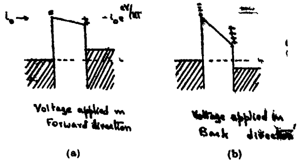

$i_0 \rightarrow$
$-i_0 e^{eV/kT}$
Voltage applied in Forward direction
Voltage applied in Back direction
(a)
(b)

Fig 6 Rectification at the barrier (a) shows the favourable distortion of the barrier when small voltage is applied in forward direction (b) shows the unfavourable effect with opposite voltages

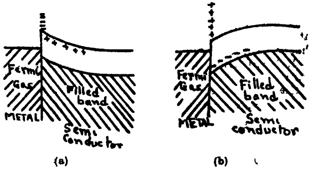


Fig 7 Formation of ractifying barrier in the case of a metal and a *n* type semiconductor is shown in the left (a), the same is shown for *p* type semiconductor in (b) on the right.

In Fig 7a the establishment of the barrier in the case of a metal and semiconductor of *n*-type is shown When contact is made electrons flow from the semiconductor to the metal and establish a negative charge density and an equal residue of positive charge remains near the surface of the semiconductor, consisting of ionised impurity levels In Fig 7b, the potential barrier for a *p* type rectifier is shown Everything is the same as in the previous case, only the condition of work function being reversed and the nature of the carriers changed The positive holes drifting like bubbles in water serve as the carriers of charge

The question of the potential barrier and of the mechanism of crossing it, is also of great importance A number of theories have been put forward, the application of which depends on the assumed thickness of the barrier. The first theory given independently by Wilson and Nordhiem in 1932, is based on the well known 'tunnel effect' It assumes a thin barrier of 10^{-7} cm The theory remained generally accepted for a number of years, until the recent observation that it predicted rectification in the wrong direction Moreover another serious difficulty arose when strong evidence was obtained that the barrier was considerably greater than 10^{-7} cm the basic assumption of Wilson Nordhiem theory

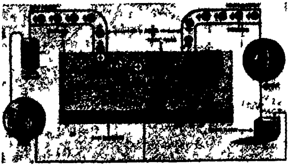


Fig 8 Diagrammatic representation of how amplification is given by a crystal transistor

In 1939, Mott came forward with his thick barrier theory in which he suggested that electrons surmounted the barrier by thermal excitation He assumed a constant field in the entire region of the barrier This was an over simplified assumption which was later on overcome by Schottky Mott and Schottky theory which is applicable to thick barriers (10^{-4} – 10^{-5} cm) assumes collisions to take place in the barrier so that the flow of current reduces to a statistical problem involving detailed balance

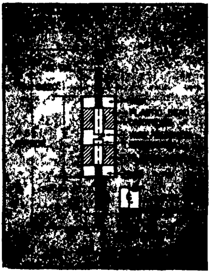


Fig 9 Constructional details of a germanium crystal

In the light of recent experimental results, neither the thick nor the thin barrier theory can be accepted Rather a theory for a barrier of intermediate thickness is somewhat warranted It is taken for granted that the barrier is no doubt too thick for tunnel effect, yet it is not so thick as would involve collisions This theory is commonly called diode theory by virtue of the analogy to the motion of electrons in a diode The carriers are thought to have sufficient energy to cross the barrier (analogous to the work function of the cathode in a diode) while these can fly unimpeded to collide against the metal (analogous to the anode)

The action of the amplifier crystal can be easily explained with the help of Fig 8 The amplifier consists of a silicon crystal fitted with a base electrode and two fine whiskers above The two whiskers, electrically isolated, have their contact points on the crystal only 0 0025 to 0 005 cm apart Voltages are applied as shown in the figure The input signal generates the 'positive hole' current This goes to the collector point where the arrival of a positive hole breaks the equilibrium of the electron swarm (barrier) and triggers a number of electrons to the base electrode Since the arrival of a single positive hole acts as a trigger for so many electrons, the output of the the collector is much larger, thus amplification is produced In popular language, the crystal amplifier and rectifier has been given the name of 'transistor'

Fig 10 A transistor ready for use shown at left, while at right is one with its cover cut away to show the key parts.

It goes without saying that the branch of solid physics dealing with impurity effects in lattices, is full of great possibilities Early in its career, the study of solid physics has given rise to crystal detectors of nuclear radiations that have found wide applications in nuclear projects The tiny detector is well competing with the bigger gaseous detectors of age old reputation And now the transistor Its successful use bids fair to make crystal rectifiers a formidable rival of the vacuum tube

BLOOD AND THE PRIMITIVE *

(MRS) HILDA RAJ

DEPARTMENT OF ANTHROPOLOGY UNIVERSITY OF DELHI

TO those interested in the cultural development of man there are two kinds of museums the kind where the specimens of man's handiwork from the earliest times are collected and the kind that has no material housing, unless it be in the form of books storing up the curious, customs, beliefs and superstitions of man, which, were they counted, would far outnumber the material specimens One such storehouse is Frazer's *Golden Bough* series containing Curiosités et Superstitions de peuples sauvages The non material "museum specimens have often a stronger appeal and a greater fascination than those tangible objects which are sometimes treasured and valued beyond the price of rubies But the value of these objects is mainly due to the fact that they mirror the thought that lies behind and the mind that dictated to the hand what it should do We treasure all *museum specimens because they are old and curious*, different from what we are familiar with, different in the pattern and design and in the shaping of both matter and sentiment Already there is a bewildering accumulation of the curiosities and superstitions of primitive peoples, and trying to find one's way through this vast dim museum is a prolonged pilgrimage A whole life may be spent in the quest and in trying to lift the veil of time one may never reach one's objective One may never know enough even if the search is for a single object, but the quest is its own reward So with this paper where I have tried to collect some illustrations of one exhibit, and tried to understand primitive man's attitude to blood

It is a well known fact that in the early stages of their cultural development primitive peoples all over the world hardly show any distinction in their attitude to material and immaterial things They seem to have no idea of tangible and intangible as belonging to two different categories—modern man is still engaged in disentangling the two To the primitive a man's body and his breath, a tree and its colour, an animal and its shadow—the material and the immaterial—have the same value, and the same potency Everything connected with a man—his body, his clothes, his ornaments, his weapons anything that has been in contact with him, have in the primitive's conception, what we might describe as 'spiritual values,' just as much as his spiritual part which the primitive does not separate There is nothing physical or spiritual as such, nothing concrete or abstract, for all things material and immaterial belonging to a man have the value of his personality —his 'mana,' or his special essence Anything that has been once attached to a man's body like his hair or nail parings, anything that goes out of his body, his excreta or his spittle, have the man's spiritual essence in them, and could be used to work evil against their erstwhile owner Among the things that go out of a man his blood whether functional or accidental has the utmost value, for it is the man himself in that it is believed to contain his very life and all his properties—it is indeed the man's personality in miniature And this is held to be true not only of the living man, but of the dead as well

To the primitive the great importance attached to blood is due to his belief that 'blood is life' This is evident from the numerous ceremonies where blood is used in the faith that it will revitalise, or give new life to a living or to a dead body The Hebrews of old firmly held that blood is the life Again and again in the Old Testament one comes across passages emphasising this belief The life of all flesh is the blood thereof, the life of all flesh is in the blood (Lev 17) and this life is identified with the soul Blood is not only life but it can also transmit life and strength, can convey to the recipient the courage and might of the owner The practices of the Australian aborigines at the time of the initiation of young boys illustrate the belief that blood gives new life and strength Older men of the clan, the kinsmen of a boy, open their veins and let the blood splash on the boy's body and they also give it to him to drink Often it is the only food the young initiate has during the days of his initiation An old man is sometimes refreshed with a drink of warm blood from the veins of a young man, and he feels that his life has been given a new lease thereby The male infant among the Caribs was sprinkled with his father's blood in order to give him his father's courage Cannibalism arose out of the belief that a man's flesh and his blood gave new strength And since the kinsman must be inviolate the stranger and the enemy had to provide the flesh and blood that the savage craved for The people of Halmahera used to drink the blood of slain enemies in order to become brave The warriors of Amboina island and the people of Celebes did likewise for the same purpose

The recipient, were it a corpse or only a skeleton, was believed to get the full benefit of blood just as much as the living The Ashanti washed the bones of their dead kings with the blood of human victims in order to impart soul life Among the Australian aborigines the kinsmen of the dead man stand over the grave and gashing themselves let the blood drip on the corpse, so that the dead man who has passed on to another place may have new life The Nicobarese kill chickens and young pigs by the side of a grave where a body is newly laid, and let the blood spurt on to the region of the heart of the deceased At their Ossuary Feast, which takes place three or four years after the burial, the bones are taken out and washed ceremoniously, and the skull is treated to a dripping of warm blood of fowls and pigs before being put back into the ground.

---

* Paper read before the Anthropology Section, Indian Science Congress, Allahabad, 1949

Since primitive man does not make any distinction between human beings and animals the blood of the latter is just as sacred to him as that of the former. But the king and the priest being no ordinary mortals, their blood contains special potency, a 'mana' which we might describe as having a high voltage. It is accepted among all primitives that royal blood may not be upon the ground for fear it might release a force too powerful to control. Hence ingenious methods are devised for killing royal personages like smothering or boiling them alive in a cauldron. Frazer gives the illustration of a king of Siam who was put into a large iron cauldron and pounded to pieces with wooden pestles because royal blood might not be spilt on the ground. Frazer also quotes a Tartar maxim 'it is highly improper that the blood of the great Khan should be spilt upon the ground, so they cause the victim to be smothered somehow or other.' The chief or a priest may not have his blood shed for the same reason that his blood partakes of his sacred nature, and any object that may come into contact with it may become subject to the same rules of taboo attached to it, for there are perils as well as life giving qualities that go with blood.

Blood can be life only when its qualities are life giving, that is when it has issued out of a being who has the elements of strength and power in him. Blood is the transmitter of whatever properties may be the distinguishing characteristics of the person to whom it belongs. Thus blood can transmit not only life and strength, but may pass on weakness and pollution which may be deadly in consequence. Thus blood becomes a vehicle of contagion for passing on weakness, cowardice and impurity and hence a source of great danger not only to an individual, but also to the social group of which he is a member.

Primitive society has put the seal of weakness and cowardice on woman, not that primitive woman was not capable of showing physical strength and valour. By her periodical discharge of blood, by her motherhood which while it gives her the glory of a procreator also causes her to shed blood, woman is a being by herself sacred as a king or a priest, but her blood is potent with greater danger, and hence must be avoided. So in primitive society we find hundreds of taboos surrounding woman and restricting her times and fields of activity. Not only is she not permitted to touch and handle man's special material goods used in his occupation, in his fighting, and for his recreation, for fear of conveying her feminine qualities to them, but during menstruation and childbirth she is isolated and kept apart so that she does not pass on her contagion to others especially to the male members of her community.

Volumes could be written to illustrate the 'savage man's horror of menstruation', because of the mysterious potency believed to be in woman's blood which is "feared or desired just as the other parts of woman, because it is a part of woman and contains feminine properties. Lowie cites the account of a French traveller among the Choctaw of Louisiana. The Frenchman prevailed upon a menstruant woman to make him some porridge of corn, which, when the husband returned, the stranger asked him to share with him. He began eating, and suddenly suspicious, asked who had cooked it, and the rest of the story goes in the words of the narrator, "when I replied that it was his wife who had been my cook, he was at once seized with sickness and went to the door to vomit. Then reentering and looking into the dish, he noticed some red things in the porridge, which were nothing else than the skin of the corn, some grains of which are red. He said to me 'How have you the courage to eat of this stew? Do you not see the blood in it?' Then he began vomiting again, and continued until he had vomited up all that he had eaten and his imagination was so strongly affected that he was sick on account of it for some days afterwards.'

Menstruation, pregnancy and childbirth are periods of mystic danger and contagion since they mark feminine crises 'when a woman is most woman.' The blood of childbirth appears to the Africans to be tainted with a pollution still more dangerous but miscarriage, especially if it is concealed, calls up all the horrors in the world to the mind of some Bantu tribesmen. For not only is the culprit's husband threatened with death, but the whole country, the sky itself may suffer. Frazer comments. By a curious association of ideas a physiological fact causes cosmic troubles. Among some Australian tribes the seclusion of menstruous women is very rigidly observed and penalties are attached to disobedience. Certain infringements might even result in death as for instance when a woman walks along the same path that is taken by the men of the Wakelbura tribal camps. The sense of horror and the attendant taboos have made woman a source of danger and ceremonial uncleanness, with the fatal gift of imparting pollution, and even disease and death. The ancient Hebrews sharing the beliefs of the Semites considered their women folk as unclean during certain periods of their life. A Hebrew woman after childbirth had to be in seclusion and isolation until forty days, after which she purified herself by going to the temple and offering her gifts. In our country we have ample illustration of this custom of observing ceremonial uncleanness and the necessity of purification, and I dare say it is not entirely due to a desire for physical cleanliness or to give some rest to the women. In South India a menstruating woman is not allowed to pass near certain plants for fear that she would cause them to wither and in my own home my mother saw to it that no woman servant plucked the leaves of the curry neem.

Blood is the bond of brotherhood and undying friendship between two individuals or within a group. The mixing of the blood of two persons is believed to make them indissolubly one, and such a bond is stronger than the bond of real kinship due to blood relationship, and no power can break up the union. That is why contracts are signed in blood between the parties

Tylor describes how East Africans perform the rite 'the two sitting together on a hide so as to become of one skin, and then they make little cuts in one another's wounds" This kind of blood contract is an ancient custom still surviving in various parts of the world The Karen of Burma and the Kyan of Borneo mix water in the blood of the parties concerned and drink it, thereby swearing blood brotherhood It is said that the Mongolians in olden days mingled gold and blood in their cup of peace for bringing about reconciliation The Turks observed a similar practice for ensuring an alliance with the Ungarian Christians The idea of sealing a covenant in blood by drinking it or exchanging it is fundamental in all primitive life Trumbull's book on Blood Covenant is full of illustrations from Africa, Asia, America, Europe and Oceania Blood is life', and when it seals a covenant it is held sacred and unbreakable Howitt in his *Tribes of S E Australia*' gives the illustration of an Australian aboriginal seeking reconciliation with a dead man by licking the blood or the liquid exuding from the corpse The belief that blood unites the sons of two persons is illustrated by the story of an Arab in ancient times as related by Robertson The Arab newly married was attacked He killed his bride, and smearing himself with her blood fought till he fell By smearing himself with his wife's blood he united her soul with his Blood is used also to prevent treachery on an unwary party, as seen in the case of gipsy thieves in Serbia who put their own blood into the food of one who suspects them and is expected to betray them

The practices with blood in the ceremonial life of the primitive are countless Blood used for purification has led to some of the most elaborate rituals Purification is considered essential where the pollution is not so much physical as moral—so great is the horror caused by pollution Mere washing will not do away with the uncleanness incurred In South India the *Nayadis* are so low among the untouchables, and contact with a *Nayadi* is so foul a pollution, that a man in order to purify himself must bathe in seven different streams and seven tanks and then cut his little finger and let out a few drops of blood if he is to absolve himself of all contamination The following passage from the Book of Leviticus describes how the priest of the Hebrews was instructed to cleanse the people of their sins

> He shall go out unto the altar that is before the Lord and make an atonement for it and shall take of the blood of the bullock and of the blood of the goat, and put it upon the horns of the altar round about. And he shall sprinkle of the blood upon it with his finger seven times, and cleanse it and hallow it from the uncleanness of the children of Israel

Blood is usually avoided because of its identity with life and soul It seems almost strange that people should use blood for their food, raw or cooked Hutton gives the example of the Angami Nagas eating blood boiled in water or alone, sometimes raw and mixed with other food I have personal knowledge of people who, untroubled by any revulsion or superstitious fears, cook and eat blood When goats are slaughtered the blood is collected for cooking to be eaten or for medicinal purposes Goats blood is believed to be good for women s diseases The Angami Nagas use chicken s blood mixed with raw eggs for a fractured skull Crawley in the Mystic Rose mentions that the Central Australians administer blood from the genital organs in cases of severe sickness He further cites the custom of the Australians giving blood from a woman s sexual organs to a sick man and rubbing his body with it This illustrates the fact that though contact with woman s blood must be avoided it is resorted to on extraordinary occasions on account of its special potency, as though the risk were worth taking when a man's condition is very serious Human blood was given to a sick man to drink in Tasmania, the Beni Amer cured their sick by bathing them in the blood of a girl or of some animal That human blood was believed to cure leprosy is illustrated by Mills in a note in his book on the Rangma Nagas The Konyaks have a horrible remedy In 1932 a leper of Longmien smeared himself all over with the fresh blood of a beheaded enemy in the hope of getting rid of the disease" According to Trumbull blood bath was supposed to be the remedy for leprosy from Ancient Egypt down to the middle ages Drinking of blood was believed to cure epilepsy from Roman times, and the belief has been fairly wide spread

It is difficult to tell where medicine ends and magic begins in the conception of the primitive Ancient medicine and ancient magic were often one Disease being believed to be the result of magic or due to some angry or envious spirit, or offended deity or due to the breaking of taboos, it is obvious that the cure also should be sought through supernatural means Almost all the examples referred to above come within the field of magic for blood is believed to have magical properties, and blood is a lifegiver Blood letting has been recognised all over the world as a cure for certain ailments, and the aid of leeches in sucking the 'bad' blood is usually sought But among the Stone Men of Malekula blood letting is performed as a magical act since it is believed to remove the evil influence, and thereby bring about the cure Blood may be used in love magic a young Magyar woman believes that by rubbing her blood in the hair of the man that she loves she can make him love her

The magical use of blood is best seen in fertility ceremonies of which the Intichiuma of the Australian aborigines come readily to the mind These ceremonies are intended to multiply animal and plant totems The underlying belief is again in the transmissions of the life giving properties of blood for fruitfulness The men of Kangaroo totem open their veins and let the blood drip on the sacred stone hallowed by the Kangaroo ancestor thereby giving more life to the totemic species The participants in the ceremonies also paint the totemic symbols on their bodies with blood drawn from the arm or the genital organ The Reddis of the Bison Hills are reported to sprinkle the blood of the sacrificial animal on the seed grain of different crops This ceremony takes place along with other rites at the festival of *Bhuma Devata*, or the Earth Mother, with invocations like "Oh mother, we give you an offering, may our crops grow and ripen, hail! There are some grim accounts also of human sacrifices, of unsuspecting men snared and killed, and their blood used for rites to increase the harvest of the field

Grigson describes how the Maria Gonds of Bastar soak the grain seeds in the blood of cocks and pigs believing that thereby they have ensured the fertility of their fields He also refers to the secret manner in which the Marias try to obtain human blood, especially the blood of women to mix with their seed The usual methods is to go to a distant village at night and inflict slight wounds on sleeping women with a knife or an arrow The blood stained weapon is taken home, and washed in water which is used for steeping the rice seed before sowing Verrier Elwin gives several instances where human blood was used among the Marias to make a barren woman fertile, and children were secretly killed for the purpose He further refers to the craving of a witch for the flesh and blood from the buried body of a youth she had desired From Central Australia comes the illustration of how the wizards of the Dieri cut themselves and use the blood for rain making ceremonies Blood is sometimes sprinkled on the ground by the husbandman in order to propitiate the ground demons who in their malignity might cause destruction It may not be out of place to mention here an incident from *Primitive Semitic Religion* by Curtiss He says that when the railroad from Beirut to Damascus was built ten sheep were placed in a row and their throats cut to let the blood flow upon the ground It is in the realm of black magic or witch craft that the nefarious practices with blood seem to take place Blood along with hair, nail parings etc are used to work evil, and the ancient Peruvian sorcerers destroyed their victims by obtaining their blood and using it against them

The various uses to which blood is put in the totem ceremonies of the Australians stand midway between magical and religious uses The wall of separation between magic and religion is very thin, or does not exist for the primitive His objects of worship, spirits and deities conceived on anthropomorphic lines, and to his mind endowed with the same appetites, preferences and needs as he, require of him gifts of blood, human or animal on special occasions That the immaterial spirits should require material food does not seem incongruous to the primitive Departed souls thirst for blood, and this life-giving beverage is poured into graves or tombs by means of a tube or a funnel In the Greek cults of the dead sacrificial blood was poured into the grave, and the flesh of the animal burnt nearby ' for a sweet savour" Vampires have a great weakness for blood and they are believed to suck the very life out of infants In the Book of the Dead an Egyptian god is addressed "Hail thou who dost consume blood '

Sacrifice is at the very centre of primitive religion, and blood finds the central place in the ritual of sacrifice Blood is the passport to the spirit-world and to the presence of a deity, it is more the food for the gods than for mortals In the ritual of Attis, on the Day of Blood, the priest made a sacrifice of his own blood, then the minor priests slashed their own bodies and let the blood splash on the altar and the sacred tree The sacrifice of human victims to placate an angry deity was gradually replaced by the offering of animals In the secret ceremonies of the worshippers of Attis a novice had to take a bath in bull's blood, and the devotees of Dionysus in a frenzy of worship used to rend the sacrificial bulls and goats, and drink their hot blood The Old Testament contains very strict codes regarding the sacrifice of animals and blood offerings The manner of the disposal of the blood is referred to again and again, for blood being 'life' and the 'soul' of the animal may not be poured on the ground, but sprinkled on the altar, or on the persons assisting at the sacrifice Always the choice of animals had to be special, unblemished and spotless ones being preferred

The worship of '*Gramma Devata*' or the village tutelary deities of South India are accompanied by animal sacrifices, and the occasion have all the importance of great festivals It is mostly the *Ammans* i e, the female deities that delight in the offerings of blood Sheep and fowls are the common victims At the festival of *Mariamman* (she is the bringer of small pox) sheep are sacrificed, and the blood is collected in earthen vessels This is mixed with boiled rice and sprinkled in the enclosure of the shrine and in the four corners of the main street through which the image of the goddess is taken in procession During the festival of *Pidari*, another female deity, a male buffalo is sacrificed, the blood is collected in an earthen vessel and placed near the image of *Pidari* During the night the deity is supposed to have drunk most of the blood, and whatever is left is poured away outside the compound of the shrine The rice and blood thrown in the streets is meant for evil spirits to catch The spirits that guard boundaries are treated to balls of rice and blood, and the ceremony takes place at night, the officiating '*pujari* not daring to look behind after he had thrown the balls in the air, and the earthen vessel which had contained the offering is dashed to the ground

The ceremonial drinking of blood has already been mentioned in connection with initiation ceremonies Now I like to refer to the drinking of blood by the *Marudhali*' or man who is possessed by a deity In Tiruchiyapalli I have seen year after year the '*Marudhali* possessed by the deity known as *Kulumai Amman* drinking the blood of kids out of a silver bowl, and then sucking the blood from the throat of kid after the kid just cut and held up to him as he was carried aloft on the shoulders of two men. At this annual festival two to three thousand kids had their throats cut for the *Marudhali*' to drink blood The festival of *Kulumai Amman* has become less and less popular, and it may gradually die on

The prophylactic qualities of blood are illustrated by the smearing of doorposts and lintels with the blood of a sacrificed animal The institution of the pass-over is a very interesting example The Israelites were saved from the plague that smote the Egyptians because they followed the injunctions of Moses who told them to sprinkle the lintel and the two side posts of their doors with the blood of the sacrificial lamb A parallel illustration is given by Frazer about the high priest of the Grebo people in Sierra Leone, the door posts of whose house had to be sprinkled with the blood of a sacrificed goat In China during times of of pestilence magical formulae were written in human blood and fastened on doorposts as a protection against the disease In our country the painting of doorposts and thresholds with red bands is a likely survival of this ancient custom of smearing blood to ward off evil The colour of red stands for blood with some people Among the Stone Men of Malekula red yam symbolises blood, and it is given to novices to eat at their initiation The juice of a red fruit '*rori*' also represents blood to them Among the Maori red is a sacred colour, and it is used for painting objects that are tabooed When a Maori chief lays a taboo on any thing, he sets up a post that is painted red Any place where a corpse had been set down is marked by a stone or tree that is painted red The taboo on blood extends to blood like things or red coloured objects The West African native regard red earth as having been stained by the blood of the victims killed by a demon Red earth used for smearing the body is a substitute for blood, thus red ochre or red clay dissolved in water has the symbolic value of blood itself Red is the colour of blood—it is the colour of life, health and strength

From all that has been said so far it will be evident that the primitive has surrounded blood with all kinds of taboos Blood is sacred and holy, so it may not be lightly handled It is charged with a mysterious power which cannot be gauged, a power which is neutral in itself, but in the process of application might turn out to be beneficial or harmful Blood is forbidden when it is ceremonially unclean in which case also it must be carefully handled, for it is potent with danger, and no one can tell what evils it might cause Prohibitions regarding blood were very stringent among the Hebrews because it was considered to be too perilous to be the food of man There is a passage in Deuteronomy (12 23) "Only be sure that thou eat not the blood For the blood is the life, and thou mayest not eat the life with the flesh" Again (Gen 9 4) "But flesh with the life thereof which is the blood thereof, shall ye not eat

The primitive has no compunction about killing he is not troubled by any moral precepts such as we are familiar with, but anything that affects the safety and well being of himself, his family and more important still, his social group, is his prime concern And a mysterious soul-power which is bound to be inimical to the man who sheds it, unless he neutralises it by some ritual before or after When blood is shed it cries out for revenge, and the murderer is guilty not because he has killed, but because he has spilt blood He becomes ceremonially unclean, society ostracises him on account of his pollution—that is the punishment for his crime until he purifies himself The starting of blood feud, and the keeping up of the feud for many generations, is a long story by itself

Primitive man's taboos are not meaningless It was not reasoning but an unerring instinct that prompted him to regulate, stabilise and conserve his society by numerous taboos in every sphere of his life. Wundt calls taboo "the unwritten code of law of humanity" And this law was punctiliously obeyed by primitive man, because, as Freud says, "an external threat of punishment is superfluous, because an inner certainty (a conscience) exists that violation will be followed by unbearable disaster"

In my study of this subject the selection of material has been difficult, for there was so much to choose from, and the temptation was to go on collecting But I had to restrict myself to a few salient points and a few illustrations from here and there to show with what reverential fear and caution the primitive approached blood which roused in him strong emotions The illustrations also indicate his ambivalent attitude—his desire for the strange and the forbidden and his horror of the inexplicable and the mysterious The difference in the mental processes of the primitive and the modern man is not in the reasoning but in the premises of reasoning To the primitive "blood is life" and blood gives life We see the truth of this in the transfusion of blood However there is this difference to the primitive—blood is not only life, and life is blood, but it is also 'the normal and visible soul, when a man bleeds to death his soul is seen leaving the body In transfusion as we know it blood has no other value but with regard to its physical properties, whereas to the primitive the psychic value is tremendous and he cannot separate it from the physical

Already the attitude to blood is changing among primitives, wherever modern scientific knowledge has begun to penetrate Many rituals have lost their value and their meaning Sometimes the ceremonies being kept up solely as a part of tradition and the grip of taboos is also gradually slackening A study of ancient customs and superstitions is interesting and valuable for the light that it can throw on curious practices still persisting in our own country and elsewhere Besides in such studies of the primitive we recognise ourselves with a mild shock of surprise and these revelations are greatly diverting Though fear urged the primitive to many curious practices these same practices, honoured in his rituals, filled his life with excitement and rapture, adding colour and glamour to his otherwise limited, and often drab life Primitive culture in all its aspects is of value to us, for it is a part of the cultural wealth of the human race

HIDEKI YUKAWA:

NOBEL LAUREATE IN PHYSICS FOR 1949

HIDEKI Yukawa, Professor of Theoretical Physics at the Kyoto University in Japan is the first Japanese physicist to be honoured by the Nobel award Theoretical physics in Japan, however, took fruitful root from the early years of this century and the names of Nishina and Sakata are familiar to all physicists Yukawa like many other Japanese physicists received part of his training in Germany where he came into contact with the rapidly developing quantum mechanical theories in the nineteen twenties He had the opportunity to come into close contact with men like Heisenberg and was early interested in the subject of field theories This early interest he has retained and most of his subsequent work bears the marks of his absorption in the problems of field theories In 1935, Yukawa made an attempt to explain the strong forces between the neutrons and protons constituting the nucleus in terms of a field of force on the basis of a relativistic equation In analogy with the electromagnetic field, which gives rise to the Coulomb force, Yukawa assumed a field which would give extremely short range forces as are found in nuclei He chose the potential of the type f^1exp kr)/r and obtained the neccessary short range of about 2×10^{13} cms the range of force between neutron and proton by choosing the inverse of k to be of the same order From an analogy with photóns, since 1/k has the dimensions of length, he postulated a material particle of mass 200 m_e, which would give the de Broglie wave length of h/mv of the order of 2×10^{-13} cms The mass m is then about 200 electron masses This early paper in the *Proceedings of the Physico Mathematical Society of Japan* in 1935 did not attract the attention it deserved until a couple of years later Street and Stevenson first pointed out that in some of the photographs of cosmic ray particles obtained in a Wilson colod chamber placed in a magnetic field tracks whose curvature and ionisation density pointed to a mass for these particles intermediate between that of an electron and a proton Anderson & Neddermeyer in 1938 found similar tracks and estimated the mass at about 200 electronmasses Almost simultenously, various workers in the field of cosmic rays reported observing these particles and published photographs of tracks and a tentative determination of the masses placed most of the tracks observed as produced by a particle of mass about 200 electron masses This particle was called variously meson, yukon mesotron etc The discovery of this particle was a brilliant vindication of Yukawa's work Using Yukawa's picture of treating the meson like a quantum associated with the nuclear field, attempts were made to associate this particle with the known nuclear processes like β decay It was found that this particle, the meson, decayed with a lifetime of about 2×10^{-6} seconds and cloud chamber evidence showed that the meson decayed into an electron and one or more neutral particles (still unknown), which tended to confirm strongly the relation between the meson and the nucleus on one side and the meson and the electron and neutrino on the other The development of the meson theory from this point onwards seemed to be successful in the qualitative interpretation of all phenomena so far known in the field of cosmic rays as well as in the field of atomic nuclei However, strangely enough it could never arrive at the stage of quantitative agreement with experiments This sums up the rather puzzling situation of the meson theory in 1947 The situation was somewhat cleared up by the experiments of the Rome group and the Bristol group published in 1947 Although at first sight the work of the Bristol group seemed to add to the confusion by establishing two groups of mesons, this was cleared up and further confirmed by the experiments at Berkeley with 400 mev alpha particles and 350 mev protons on targets of graphite and other elements, with the newly installed synchro cyclotron The facts that seem well established are (*i*) that the main constituent of the hard component of the cosmic rays is the μ mesons which are the lighter ones They have little interaction with nuclei and decay with a half life about 2 15 micro seconds and necessarily have nothing to do with nuclear forces (*ii*) The heavier meson *i e*, π meson with a mass of about 300 electron masses, interact

Prof Hideki Yukawa

strongly with nuclei and decay into the μ meson with a lifetime of the order of 10^{-8} seconds (iii) The π mesons occur with both negative and positive charges, the negative π mesons are easily captured by nuclei and its rest energy of about 150 mev is transferred to the nucleus which causes the disruption of the whole nucleus These nuclear disruptions, once a familiar phenomenon in cosmic rays have now been produced artificially and studied They give rise to the belief that the negative π meson has a spin that is integral and one would expect that the positive π meson has also an integral spin of the same value The problems of the various types of mesons have given rise to many radically different theories which are yet to be experiementally verified The experimental determination of the properties of the different types of mesons are being vigorously carried out at different schools by means of photographic emulsion, Wilson Chamber and Counter techinques A recent work of Rabi *et al* demonstrating the interaction between neutrons and electrons, the depth of whose potential is of the order of a few kilovolts extending over a distance of the size of the electron has given support to a pseudoscalar type of meson field for nucleons Another important type of experiment is the neutron proton scattering experiments at high energies performed at Berkeley, which show approximately equal scattering in backward and forward directions at energies of the order of 100 mev of incident neutrons This seems to indicate fairly clearly that there are both exchange force and ordinary forces in almost equal porportions There is also the evidence for the multiple production of mesons at very high energies which have to be accounted for in any complete theoretical description of meson phenomena Inspite of these problems the recent developments have bridged the gap between cosmic ray phenomena and those observable in laboratory experiments in nuclear physics The position is by no means clear the relationships and laws that govern the plethora of fundamental particles is still in its early stage of formulation although the position is better today than it has been in years Difficulties in collecting sufficient experimental data stand in the way of verifying some of the most interesting predicted properties of mesons But the prospect is not altogether gloomy The experimental verification of the highly abstract predictions of Dirac's Hole Theory and Yukawa's Meson Theory ring a note of hope

Professor Yukawa, now visiting Professor at the Columbia University is actively working on field theories to find a place for the various known particles and others that probably exist, in a single, if not simple, system Prof Yukawa's contributions to the state of knowledge at present, is certainly significant and in some ways unique It is also by no means ended He is only 43 and is still an important contributor whose insight has earned for his opinions, universal respect and acclamation

B D N and R D

Notes and News

NATIONAL LABORATORY AT HYDERABAD

In addition to a chain of National Research Laboratories in India, regional research laboratories are also on the way to their establishement for tackling urgent local problems

The foundation stone of Central Laboratory for Scientific and Industrial Research, at Hyderabad (Dn), was laid on November 6, last by H E Maj Gen Choudhury, Military Governor of Hyderabad The laboratory will work in close collaboration with the National Research Laboratories of India A sum of Rs 8 lakhs for equipment and Rs 25 lakhs for building has been provided by the Hyderabad Government for the purpose

The annual recurring expenditure is estimated at about Rs 4 lacs and the laboratory will have a staff of 100 members.

The Board of Scientific and Industrial Research (Hyderabad) set up in 1941 has been providing an annual grant of Rs 60,000/ for research schemes on Vegetable Oil, Fuels, Ceramics, Fibre, Pharmaceutics and Drugs Forest Products and Heavy Chemicals Investigations on these will now be continued at the new regional laboratory

Research work in the laboratory will be both of fundamental and applied nature along the lines of promotion of chemical industries, technical development and utilization of regional raw materials

The work in the laboratory may take the form of improving old industrial processes in the light of the newer scientific knowledge or inventing new processes It is also meant to solve the various technical and scientific problems that tend to arise in the working of the industries

Speaking on the occasion, Dr Hussain Zaheer, Director of the Central Laboratories, stated that they were planning to set up in the near future a small 25-ton-a-day capacity low-temperature carbonization plant at a cost of Rs 6 lakhs

"This installation is expected to give not only about 20 tons of smokeless fuel useful for household purposes as well as a good substitute for charcoal and coke for all types of blast furnaces except the metallurgical, but also the by-products necessary for experiments on a large scale for the preparation of synthetic motor fuel and lubricants "

Dr Hussain Zaheer said that they were also conducting research on oils and oilseeds It was shortly proposed to set up a plant in the Central Laboratories for the extraction and refinement of cotton seed oil at a cost of about Rs 3 lakhs

The Governing Body of the laboratory include H E Maj Gen J N Choudhuri, *President*, Hon'ble Shri C V S Rao, *Vice-President*, Sri S N Bilgrami, Sir J C Ghosh, Dr A M Heron, Sri V Krishnamurty, Dr S P Raju, Hon'ble Sri C V S Rao, Hon'ble M Seshadri, Sri C S Tyabji, Hon'ble Nawab Zain Yar Jung Bahadur, Nawab Ali Yaver Jung Bahadur, and Dr S Hussain Zaheer, *Members*

INDIAN CENTRAL JUTE COMMITTEE

The first annual report published by the Indian Central Jute Committee after the partition of India is just published and covers the period 1947-48 The report shows some important changes made in the constitution and rules and regulations of the committee due to the changed political situation in India since 15th August 1947, and specially because the committee had to wind up all its activities in East Bengal in the new Pakistan Dominion

The report giving a short account of the work of the committee in all its branches is divided into five chapters—dealing with the constitution and meetings of the committee, with the scientific investigation on jute under three heads of (*a*) Agricultural Research, (*b*) Technological Research and (*c*) University Research schemes, the economic investigations on jute in the three sections of Economic Research, Marketing and Publicity, and other general matters

The report specially mentions that in the year under review while the progress of work in all other sections continued almost at normal speed the work of the agricultural section was badly affected by the partition of India, as the agricultural laboratory at Dacca had to be shifted at Chinsurah, Hooghly, in the Dominion of India, and the marketing section in view of its reduced activities was amalgamated with the Economic Research Section

The report concludes with eleven appendices of which five are printed in separate pages and the appendix X containing the summary of receipts and expenditures from its inception in 1936-37 to 1947 48 The grant-in-aid from the Government of India increased from Rs 20,000 in 1936-37 to Rs. 8,62,800 in 1947-48

The progress of the Agricultural Research appears to have suffered various set backs due to "the loss of valuable seeds, rare apparatus, important experimental data, records of the past years along with the loss of a number of experienced officers" mainly as a result of the partition

It has been reported that the crops sown at Dacca, Narayanganj and Konda suffered from unfavourable climatic conditions, communal troubles or over growth of weeds In the chapter on "Breeding on jute" it has been stated that the fate of an improved strain of *olitorius* supplied for multiplication to the Economic Botanist (in charge of the Fiber Section) was not known, the data of the early varietal trials conducted for the third year at Belakoba, was left behind at Dacca, over 2000 selections of multiple crosses were lost and 60 progenies of stem rot resistant materials were "damaged by miscreants" Experiments on "vegetative rapprochement as a means of overcoming interspecific cross incompatibility in jute" a method which had given excellent results in other crop plants—were not continued and the crop sown for determining the "effect of date sowing on plant growth, flowering and fiber yield" failed, as timely intercultures could not be given

Very little progress appears to have been made in pure genetical studies, the same are the fates of anatomical and cytological investigations also Experiments on the retting technique and biochemical studies, which were proceeding according to schedule, were also abandoned

In the 'subvention trials" one type C 39 212 appears to have fared well in Bihar but the results from Bengal and Orissa were not obtained But some progress has been made in the control of pests and diseases

On the whole, one gets a very gloomy picture on the future of this important "dollar earner" in the Indian Union, when going through the report of this section There is a feeling that the committee with a little foresight both before and after the partition could have transferred at least small quantities of the improved types of seeds and duplicated records to Calcutta, during the period intervening after the partition and before the station was taken over by the Pakistan authorities This would have provided for the Indian Union valuable data and materials built up for decades past Under the circumstances it is doubtful whether the Indian Union may be self sufficient in Jute by 1950 or 1951

CENTENARY OF ROORKE ENGINEERING COLLEGE

The centenary celebrations in connexion with India's oldest engineering college from November 24 26 last coincided with its conversion into an engineering university

Started in 1847, in a very modest building—"two classrooms, a principal's office and four verandah corner rooms for the head master, drawing master, book dept, and store room"—it has ever since been one of the foremost engineering colleges in India

Its past students have played an important part in most of the engineering projects of Northern India, and include such distinguished engineers as Sir William Willcocks, of Egypt and Iraq fame, Sir William Garstin, Mr F R Bagley, Sir Ganga Ram of the Punjab Rai Bahadur Jwala Prasad, Sir Lakshmipati Misra and in more recent times Rai Bahadur A N Khosla

The construction of the great Ganges Canal created an urgent demand for trained engineers, and Roorkee the site of the Solani Aqueduct—for many years the longest in the world—the canal workshops, and the headquarters of the Bengal Sappers and Miners, where "a number of scientific and experienced officers were constantly assembled on the spot or occasionally resorting thither," was an obvious home for an institution which was to impart "that careful and systematic instruction which is necessary for the formation of an expert civil engineer '

Addressing the inaugural Convocation of Thomason Engineering University, Pandit Nehru emphasized the need for co ordinated planning in India to avoid overlapping and for taking up projects which were of No I priority

Sir H P Mody, U P Governor, presented the Charter of University to the Vice Chancellor Mr A C Hart, in a silver casket

Pandit Nehru said that there was a great deal of talk in India about development schemes and projects Everybody cried about the need for industrializing the country, but the picture seemed to him to be entirely confused There was no attempt at unified thinking and no co-ordination of thought not only in different parts of India as between the provinces aud the Centre but even in each department of governmental activity ' Some of our provinces behave as if they were almost independent countries " They did not think of developing India as one co ordinate whole The plans, therefore overlapped, resulting in waste of national labour and energy

Resources of skilled manpower and finances in the country, the Prime Minister said were limited and India could not afford to waste them Though they held some kind of conference or other in Delhi almost every week he had come to the conclusion that a method of co-ordination as between the Centre and the provinces and between each department of the Government had not been evolved so far

Inaugurating the centenary celebrations of the Thomason College of Engineering, Sir Homi Mody the first Chancellor of the Roorkee University of Engineering emphasized the noble task which lay ahead of Indian engineers in creating a new India where poverty, hunger and disease would be non existent and her vast resources fully utilized for the good of the people.

Engineers, he said, should not only give the country their professional skill but be also imbued with a missionary spirit

"Popular Ministers," he added" may be carried away by their enthusiasm and zeal for achieving national reconstruction, but the duty of engineers is to see that their approach to the problems before them is impartial and scientific Their's will be the responsibility for the soundness and success of the many schemes which will be projected in the years to come for changing the face of the land "

NAMING THE ELEMENTS

The first announcement of the decisions of the International Union of Chemistry, taken at the Amsterdam Conference in September, to adopt newnames for a number of elements was made at the 116th International meeting in Atlantic City, New Jersey, last week, of the American Chemical Society Most of the names are new only in the sense that they have not before had formal recognition or were one of alternatives

One of the many decisions at the Amsterdam Conference was that tungsten, No 74 in the periodic table, the hard metal used in the manufacture of electric light filaments, steel alloys and cutting tools, would be internationally designated wolfram Recognition of niobium instead of columbium as the official name of element No 41, and the confirmation of the names of plutonium and the seven other new elements discovered during the war were among the other outstanding decisions made at the Union Conference Among the names approved was that of promethium for element 61

' Wolfram ' comes from wolframite, the ore in which the elements was first discovered Oddly, the accepted symbol for the element has been W, even in the United States and England, where tungsten was the name generally employed The change from columbium to niobium for element 41 also is of special significance to American scientists and engineers, for columbium has been the American name while niobium has been the choice of England, France, Germany, Russia, and most other countries

Other names adopted officially for older elements are beryllium, rather than glucinium, for No 4 , hafnium for No 72 , lutetium rather than lutecium for No 71 and protectinium rather than proto acitinium for No 91

As had been expected, the so called transuranium elements, man made in connection with the atomic bomb project, received the names proposed by their discoverers— neptunium for No 93, plutonium for No 94, americium for No 95, and curium for No 96, The four other synthetic elements named by the International Union were, technetium (43), promethium (61), astatine (85), and francium (87) (*The Chemical Age*, October 8, 1949)

RADAR METEOROLOGY

Since 1941 microwave radar has come into use and it is found that rain, snow, and clouds from which rain or snow are falling give distinct radar echoes There is a simple relation between the intensity of the rain and the strength of the radar echo It is now possible to detect rain belts approaching from more than 150 miles away and hence forecast to within a few minutes the time of arrival of rain at a given spot In tropical regions this signalling of rain is very important for short heavy showers of rain can make aircraft landing impossible

Inside cumulo nimbus clouds there are often convection currents so violent as to be very dangerous to aircraft But such clouds are usually associated with heavy precipitation so that they can very easily be detected by radar Apparatus for this purpose may be airborne and it detects heavy rain clouds up to 40 miles away

In a cloud which is not precipitating the drops are too small to give appreciable radar echoes But light can be reflected very efficiently from them So a combination of optical methods with the pulse technique that characterises radar gives a method (called Optical radar) of measuring the distances of clouds By means of a spark gap placed in a searchlight mirror light pulses of less than one microsecond s duration are sent out They are reflected from the cloud collected by another searchlight mirror which focuses them on a photoelectric cell The current from this is used to make a pip on a cathode ray tube as in ordinary radar The position of the pip gives the time for the light s double journey to and from the cloud and so gives the distance of the cloud This device has proved capable of dealing with clouds at 18 000 ft even in broad day light

This combination of optical and radar methods has been applied to the problem of estimating the density of the atmosphere at great heights Standard radiosonde methods enable the density to be measured up to heights of about 60 000 ft but they are difficult to extend beyond that height Rockets of the V2 type will give measurements up to 60 miles or more but they are not suitable for frequent routine measurement Optical radar gives a method for measuring the density of the upper atmosphere using grounded apparatus only The method is quite simple and measurements can be made continuously As light passes through air a portion of it is scattered and hence some is reflected back towards the source The amount so reflected depends in a simple way on the density of the air An apparatus is used to send pulses of light vertically upwards. There is no clear pulse reflection since some light comes back from every altitude The cathode ray tube thus shows a continuous curve which is in effect a graph of the amount of light scattered against the altitude And from this scattering data the density at each height can easily be calculated (*Discovery* October 1949)

SOLAR RESEARCH IN INDIA

The programme of experimental research on sunspot magnetism the variation in the structure of H alpha and K lines of calcium over different parts of the sun s disk and the estimation of the effective temperature of the sun at various points along the solar radius from a study of the CH band was continued during the year 1947 48 at Kodaikanal Observatory

To measure the contours of the Fraunhofer lines the construction of a recording photo-electric spectrophotometer for use in conjunction with the 20 foot spectrograph was taken in hand The stellar spectrograph for use with the 20 in reflector was adjusted and some trial spectra of the moon were taken with it in conjunction with the 18 in siderostat and an 8 in objective The angular grating spectrograph which was originally constructed by Mr Evershed was completely rebuilt for regular use A monochromator for use with the 20 foot combined prism and grating spectrograph was constructed The work of mounting the 20 foot concave grating of the observatory was begun A tele photo camera was constructed from parts of an old telescope for taking photograph of snow accumulation on the Himalayas

The largest sun spot group recorded during the last three quarters of a century appeared in the first week of April 1947 It attained a record area of 4900 millionths of the sun s hemisphere at the time of its central meridian passage on April 6 7 thus surpassing the record held by the great spot group of February 1946 Unlike the 1946 group the sunspot group of April 1947 was conspicuously inactive in respect of solar flares and radio fade outs A measurement of the spectrograms of this spot group taken with 20 foot grating spectrograph in the red gave a value of about 3300 Gauss for the magnetic field associated with it

During the year systematic observations of the heights of prominences in the H alpha D_3 and H beta lines were made visually with the prominence spectroscope and the values obtained were compared with the heights of the same prominences in the K line from spectroheliograms On the average the visual observations gave smaller values for the heights The mean height in H alpha and D_3 were nearly the same while the values for H beta were 25 per cent less

A proposal was received from Dr d Azambuja the President of Commission II of the International Astronomical Union communicating a scheme for notifying geophysicists all over the world whenever exceptionally bright eruptions are observed on the sun at any of the observatories participating in the international Solar Physics programme The object of the scheme is to investigate the correlation between solar flares and associated terrestrial phenomena The Meudon Observatory in France is to collect the messages and to broadcast them at fixed times Kodaikanal Observatory agreed to co operate in the scheme and a message relating to a brilliant solar flare was sent on the 19th March 1948 Dr d Azambuja informed that this was the first message of the kind since the inception of the scheme

Preliminary steps for the implementation of the **development scheme of the Kodaikanal** Observatory **were taken during the year** Plans were prepared for a dome for housing the 20 in reflecting telescope received at Kodaikanal many years ago from the old Taktasinghji Observatory, Poona

To study the suitability of Kodaikanal for coronagraphic work, systematic visual observations of the sky and seeing conditions continued to be made during the year An analysis of one year s data showed that in general favourable conditions for coronagraph work prevailed more frequently in the forenoon than in the afternoon and that the first half of the year was more suitable To get the quantitative data regarding the variation of sky intensity in the neighbourhood of the sun, a photo-electric photometer was mounted on the equatorial of the photoheligraph and observations were taken on some clear days Steps were also taken to get a simple visual sky photometer which has been developed by the Harvard College Observatory for the same purpose

ON SHORTENING SCIENTIFIC PAPERS

There has always been a need for shortening papers but to day this is becoming accurate With the soaring cost of printing and production editors and publishers of journals are being compelled to cut down the number of pages per volume

To day no man can keep with all that is being published, even in his speciality Under these circumstances, the writer whose papers are most likely to be read is the one who makes them short and interesting

A good writer edits his writings as ruthlessly as he would those of a stranger Sometimes in order to do this the better, he puts a paper away for a month or two until he can look at it dispassionately, and then he will wonder how he could have written such stuff

Most papers are not injured by shortening they really are improved and the author is benefitted A writer is wise to leave out long introductions Usually all that is necessary is a brief statement to the effect that there is a need for certain information to fill a gap in the world's knowledge or to settle a controversy The writer will then say that he thinks he has filled the gap or helped to settle the controversy In other cases, he will say that he has discovered something new

The experiences of the editors with authors indicate a general willingness to follow the suggestions of the editors, here and there they come across an obstinate author who insists that his manuscript is sacrosanct The author who refuses to co operate suffers the greatest loss, for the busy scientist soon learn to ignore the verbose writer (*Chemical and Engineering News*, 1949, p 2681)

LOW TEMPERATURE STUDIES

In an attempt to determine how matter behaves at temperatures a fraction above absolute 0°, the temperature 0 1° above absolute 0°, i e , 459 7°F, has been produced, and it has been found that matter undergoes radical changes at such temperatures Liquid helium flows uphill, and the flow of electricity in a wireencounters no resistance The studies which utilise this low temperature may be of great significance to future power transmission, if the super conductivity of metals can be thoroughly understood the result might be more efficient and cheaper distribution of electricity (*Chemical and Engineering News* 1949)

MANGANESE FROM INDIA

The export of manganese and kyanite ores from India in the first five months of 1949, showed a substantial increase over that of the corresponding period in 1948 The United States of America received the largest supply, 1 43,000 tons, U K received 50 000 tons, Belgium, Germany and Japan received 30,000 tons (*Chemical and Engineering News*, 1949,

TO FIGHT DISEASE

Nu 445 a new sulphonamide of considerable promise is 3 4 dimethyl 5 sulphanilamido isoxazole and is designated by the trade name, *Gantrisin*, and is found to be effective against urinary infections, pneumonia and some forms of meningitis Unlike other sulpha derivatives, *Gantrisin* is reported by the manufacturers as having of a remarkably high solubility over a wide *p*H range This would eliminate the problem of crystallisation in the kidneys, so often encountered with sulpha drugs in use at present

A special DDT—formula is being used by the Division of Malariologic of Venezuela s Department of Sanitation and Social Welfare to eliminate malaria in rural areas The malaria mortality rate of 190 8 per 100,000 of population in 1945 was reduced to 3 6 in 1948 In Cojedes, the mortality rate fell from 575 per 100,000 to 48 1 (*Chemical and Engineering News*, 1949)

INDIAN SCIENCE CONGRESS

The 37th Session of the Indian Science Congress will be held at Poona from January 2 8 1950 Prof P C Mahalanobis F R S is the President elect and the Hon'ble Dr Syamaprasad Mookerjee, Minister, Industry and Supply Govt of India will inaugurate the session Sir Robert Robinson, Prof J D Bernal (Gt Britain), Prof Hermann Mark (U S A), M and Madam Joliot Curie (France) Prof Englehardt (U S S R), and Prof E U Condon (U S A) are expected to attend

The following are the Sectional Presidents of the session —

Mathematics—Dr Nalini Mohan Basu Chairm Department of Mathematics, Muslim University garh, *Statistics*—Dr P V Sukhatme, Statistic viser, Indian Agricultural Research Institu

Delhi *Physics*—Dr R N Ghosh, Reader in Physics, Allahabad University, *Chemistry*—Dr J K Chowdhury, Head of the Dept of Chemistry, Bose Research Institute, Calcutta, *Geology & Geography*—Mr J Coates, Senior Geologist, Burmah Oil Company (I C) Ltd , Delhi, *Botany*—Dr Panchanan Maheshwari, Professor of Botany, Delhi University, *Zoology & Entomology*—Dr B C Basu, Entomologist, Indian Veterinary Research Institute, Bareily, *Anthropology & Archaeology*—Dr C Von Furer Haimendrof, Advisor for Tribes and Backward Classes, Revenue Secretariat, Hyderabad (Deccan), *Medical & Veterinary Science*—Dr M V Radhakrishna Rao, Assistant Director, Haffkine Institute, Bombay, *Agricultural Science*—Mr R L Sethi, Agricultural Commissioner, Indian Council of Agricultural Research, New Delhi, *Physiology*—Dr Kalidas Mitra, Nutrition Adviser, Office of the Director General of Health Services, Central Government, New Delhi, *Psychology & Educational Science*—Prof Kali Prasad, Lucknow University, and *Engineering & Metallurgy*—Mr D R Malhotra, Chief Chemist and Metallurgist, B B & C I Rly , Ajmer

ANNOUNCEMENTS

Dr K Ahmad Chowdhury, Wood Technologist, Forest Research Institute, Dehradun, has been unanimously re elected a Councillor of the International Association of Wood Anatomists for the years 1949 52 28 Nations are members of this Association

The Thirty Second Anniversary Meeting of the Bose Institute, Calcutta, was held on November 30 last at the Institute premises when Dr K C Mehta, Principal, Agra College delivered the Eleventh Acharya Jagadish Chandra Bose Memorial lecture on 'Control of Rust Epidemics of Wheat in India—a National Emergency H E Dr K N Katju, Governor of West Bengal presided

The *Fristche Award of American* Chemical Society has been awarded for the first time to Sir John Lionel Simonsen for his researches on Essential oils Since 1943 Simonsen has been the director of the Colonial Products Research Council of the Imperial Institute

A meeting of the rationalists of India will be held on December 18, 1949 at Madras, under the presidency of Sri R P Paranjpye All correspondence for accommodation may be addressed to the Reception Committee, 9 Broadway, Madras

ERRATA

In August 1949 issue column 1, p 69, line 30 *read* Dr Hammond is the University Professor in Animal Physiology and in charge of the Animal Nutrition Research Institute attached to the School of Agriculture, *for* Dr Hammond, Director of the School etc '

In the November, 1949 issue, column 1, p 200, lines 9 and 4 (from the bottom) *read* $120(1^5)$ *for* 120 (14) and γ_1 and γ_2 *for* r_1 and r_2

In the November 1949 issue, p 194, column 1, line 10 *read* Giauque *for* Quanque , p 178, column 1, line 13 *from the bottom read* Fortunately *for* unfortunately , p 179, column 1, line 33 *read* boat *for* boa,

---

LETTERS TO THE EDITOR

[The Editors are not responsible for the views expressed in the letters]

IS ASTROLOGY SCIENCE ?

Indian life has been guided by the *panchangs* or *panjikas* from time immemorial *Tithi*, *nakshatra*, *yoga*, *karuna* etc , are based on astrological concepts It is not be to wondered at, therefore, that our people should have a pro astrological fixation, and run to astrologers on the slightest pretext Every village has its hereditary astrologer, every city or town, nay, every street corner almost has its astrologers, counted not in dozens, but in hundreds Some of the leading astrologers even widely advertise the fact of their ig "Examiners, Government Board of Astrological lics," and, under cover of the prestige of the Go ment sell *kavachas*, price ordinary—Rs 12/- and special (Quick action) Rs 50/ each, and, the credulity of such of the victims of misfor taken in by such advertisements as, "write immediately to the Panditji stating the nature of your difficulties, and mentioning time and date of your birth He will solve them for you and show you the way to Fortune " One gentlemean makes claim to his being the sole State Astrologer of Bengal

Leaders of thought in all countries and ages have held, "Not a leaf falls nor a sparrow dies but at the will of Heaven," "*Tvaya Hrishikesha hridi sthiten jatha niyuktoshmi tatha karomi* (Thy will be done)," or "Nay, even the hour and the minute was fixed " This belief has persisted from the earliest times in spite of the evolution of primitive man into an Einstein It would not be out of place here to review afresh the grounds of belief in fatalism. Of course, belief in fatalism *ipso facto* does not establish astrology as a Science

They are going to mount a 200" reflector at Mt Wilson Observatory in U.S.A. It is said that the magnitude of our known universe will grow six times as large as the existing 100" reflector reveals Obviously, many unpredictable developments in astrophysical studies will follow the event But, for all practical purposes our present conception of the universe will probably remain unaffected

We conclude, the universe is a vast electromagnetic field, as it were, where integration and disintegration, and vice versa, of the ultra microscopic atom with its electrons and protons etc, and the stupendously large conglomeration of matter, commonly called stars, are going on ceaselessly That is, old stars are disintegrating and new stars forming all the while

It is believed, that some time very long ago a giant star passed by the Sun and created disturbances in its field so much so that a great projection of burning matter shot out of the Sun With the intruder receding the projection broke up into bits, and transformed into what we call the planets of our Solar system All planets revolve round their parent, the Sun

In course of time, the Earth's surface cooled and soil was formed Where soil and water met and there was no stirring of current or breeze, life began in the form of unicellular amoeba Of all elements discovered by chemistry, the phenomena of life was exhibited by certain compounds of carbon only i e these exhibited a peculiar law of growth and multiplication Over a long course of evolution, the amoeba has developed into man The growing human embryo exhibits almost all forms of life that preceded its present shape and form

Looking at it retrospectively, from the atom to our mother Earth, there seems to be an unbroken chain connecting the two, just as there is a link between the amoeba and a human baby And the two series again, are inter connected causally

About 400 ova are discharged into the uterus of the adult human female between puberty and menopause The human male ejects in his life time billions of potential human creatures A permutation and combination of the two would be capable of bringing into the world trillions of human beings In actual fact, very few children are born to a couple, and even these do not all reach old age and maturity Mathematically, we may work out a sum in probability Biology tells us that any one of the many possible arrangements of the genes and chromosomes would make a fundamental difference in the character, propensities, and capabilities of the new creature Obviously the child to be has no say in the matter

This being the origin and background of our existence, are we in a position to state that each one of us is the arbiter of ones own fate? Is one in a position to foretell how long one is going to live, what one is going to be, or how one will fare?

Like all other positive Sciences, astrology has also been built up on the basis of observation, tabulation, and generalisation It occurred to some one unknown in the hoary past to associate an event with the apparent position of the planets The astrologers' universe might be likened to two concentric spheres the smaller one at the centre being immobile and the larger one enveloping it rotating along the common axis As it seemed to those living on the surface of the smaller sphere, to wit the Earth, the inner surface of the outer sphere was, so to say studded with high power lamps, in between and among which certain luminaries moved about on fixed rails, and circled round the former The relative positions of the planets being unaltered, the heliocentric picture made no difference to the man The *sutras* or aphorisms of predictive astrology merely embody these generalisations They need checking and revision in the light of advances in mathematical science

What is to be done about it? All the world over the fraternity of astrologers flourish True but here in India alone the State encourages its study and practice, and spends huge sums of money annually in grants to institutions which teach astrology, and conducts examinations, and grants diplomas and certificates of proficiency to would be astrologers The State may not, therefore, shirk responsibility for this bias in our people It is upto it to review the position and take appropriate action

On the other hand, the body of Indian Scientists cannot also escape responsibility for this deplorable state of affairs The objectives of Science are not only to discover truth but also to combat superstition and ignorance In this context it is an obvious duty of Indian Scientists to come forward and pronounce their verdict And as astrology has been a long established State aided profession in India it would not do to take a negative stand without making proper investigations first On the other hand to leave matters where they are would be tantamount to allowing exploitation of the helpless lay public who know no better Worse still to do so would be positively to encourage and foster blind faith and an uncritical mentality in the people Good bye to Science then! Obviously, Science cannot flourish in an atmosphere of dogmatism and superstition

The need of the hour, therefore, is to organise and promote systematic investigations in the subject And, on the results, if justified ban its practice by law

AMULYA PRASAD CHANDA

37/1, Monoharpukur Road,
Calcutta, 22 6 1949

TRACE ELEMENT DEFICIENCIES IN CITRUS*

This is a preliminary note reporting a part the work carried out in the Physical Chemistry Laboratories of the University of Calcutta and lately the Chemical laboratories of the Indian Agricultu

---

* Communication from the Indian Agricultural R Institute, New Delhi

Research Institute, New Delhi, in connection with a scheme of research on trace elements financed by the I C A R This note incorporates the work done by Dr N P Datta and Messrs S C Das and T D Biswas with the Lyallpur and Satguddi samples and by Dr N P Datta and Messrs B N Mullick and K L Nayar with the Coorg samples The injection and spraying work have been conducted by Dr Datta and Mr Mullick The work was initiated by Dr J N Mukherjee and has been carried out under his guidance

In this study reported deficiency diseases of pine apple malta from Lyallpur, acid lime and orange from Satguddi Madras and loose jacket mandarin type orange from Coorg were taken up for investigation The method of approach was to have a symptomatic study of the diseases, analysis of healthy and corresponding diseased samples of leaves and soils from the areas and diagnostic injection and spray treatments The symptoms in all the three places were more or less the same a type of chlorosis akin to citrus mottle-leaf of California—yellow intervenal chlorosis with veins standing out green Some of the leaves were also smaller in size In severe cases considerable die back was found In Haradur (Coorg) a few leaves were found to have a fine network of green veins against a lighter coloured background similar to iron deficiency symptoms Analysis of soils from the above places and of samples of healthy and corresponding diseased leaves have been made The results are shown in tables I and II

TABLE I

	Depth	Clay %	Silt %	F Sand %	C Sand %	CaCO₃ %	pH	Av K₂O %	Av P₂O₅ %	Total N %	Total h.e c m.e	Av Mn ppm
Lyallpur pine apple malta Healthy	0–6	11 8	16 4	29 6	43 2	0 7	8 2	008	0 05	0 3	3 6	66
	6–12	11 5	17 5	33 6	31 0	1 1	8 2	003	0 02	0 1	4 4	40
Diseased	0 6	10 9	11 9	66 0	5 2	0 8	8 2	008	0 02	3 0	0 15	55
	6-12	9 9	14 6	60 7	2 9	1 3	8 4	003	0 01	0 1	3 2	
Satguddi orange Healthy	0–6	9 7	6 7		84 5	tr	7 8	008	005	0 05	6 8	65 5
	6 12	12 2	5 2		82 8	tr	7 7	007	001	0 04	7 4	45 5
Mottled	0 6	13 7	8 2	78 4		tr	7 9	01	002	0 05	7 7	72 5
	6 12	21 6	9 0	66 7		tr	7 8	015	001	0 04	9 6	55 [illegible]
Kutta South Coorg orange Diseased	0 6	13 8	9 3	47 5	23 2		6 3	012	01			35 9
	6–24	14 6	11 2	51 1	18 7		5 2	008	01			10 3
	24 33	21 5	11 0	41 2	23 1		5 9	007	009			553 7
	33–	33 4	17 8	34 8	14 [illegible]		6 5	009	007			110 2
Tittimati South Coorg Diseased	0–12	35 9	9 9	23 1	33 0		7 3	013	008			119 9
	12 36	37 4	9 4	19 1	34 7		7 4	014	004			185 9
	36	53 6	9 7	16 3	22 5		7 3	026	006			22 7

TABLE II

Sample	SiO₂ %	R₂O₃ %	Fe₂O₃ %	CaO %	MgO %	K₂O %	Mn ppm	Zn ppm	Cu ppm	B ppm
Lyallpur pine apple malta										
Healthy	2 5	3 9	1 3	5 1	0 8	2 1	82	18		6 0
Diseased	2 3	3 8	1 2	4 9	0 7	1 9	35	8		6 0
Satguddi Orange										
Healthy	0 7	7 3	0 6	1 8	0 6	1 4	53	22		26 0
Diseased	0 8	6 9	0 5	1 8	0 6	1 8	12	15		23 0
Satguddi acid lime										
Healthy		6 6		6 0	0 15	1 8	41	15		24 0
Diseased		5 6		5 6	0 3	1 8	20	16		16 0
Kutta South Coorg Orange				3 0			32 4	8 6	26 6	
Healthy				2 9			26 9	0 6	13 3	
Diseased										
Tittimati South Coorg Orange										
Healthy				2 1			24 3	36 6	16 8	
Diseased				2 1			22 0	6 4	15 6	
Saniversanthe North Coorg										
Healthy				3 4			49 2	18 8	16 8	
Diseased				3 2			28 8	1 3	10 5	
Horadur North Coorg										
Healthy				4 3			36 2	20 4	13 6	
Diseased				3 5			17 7	12 7	17 4	

The results show that the soils excepting those from Tittimati are richer in coarser fractions. Soils from Lyallpur, Satguddi, and Tittimati are of high *p*H. Others are slightly acid. They are all poor in respect of total nitrogen and available K_2O. The base exchange capacity is very low. The soils are low in available Mn excepting those from South Coorg. These problem orchards, as far as soils are concerend are, therefore, of low fertility and are expected to be also of low water holding capacity.

Analysis of the leaves show that there is not much difference between the healthy and diseased samples as regards their major element constituents. But compared to the healthy, the diseased leaves are low in Mn and Zn and in the case of Coorg also in Cu. The leaves from South Coorg are particularly deficient in Zn and Cu whereas the leaves from North Coorg are deficient in Zn and Mn. It might be mentioned here that spraying with a Bordeaux mixture is a common practice here in Coorg for control of fungi. In Coorg some diagnostic injection and spray treatments were conducted with various trace elements *e.g.* Mn, Zn, Cu, Fe, and B. So far response in the form greening of the leaves has been obtained from Mn, Zn and Fe. This corroborates the resulte of chemical analysis. The presence of a common Mn and Zn deficiency in citrus orchards in such widespread areas as the Punjab, Madras and Coorg is brought out and is of considerable interest.

I take this opportunity to thank Dr. Dalip Singh and Mr. K. C. Naik for samples from Lyallpur and Satguddi respectively and Mr. Verdarajan, Agricultural Officer, Coorg for his help during injection and spraying of the plants and collection of samples in Coorg and for sending reports on the results of the injection and spray treatment.

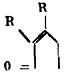
J. N. MUKHERJEE

Indian Agricultural Research Institute,
New Delhi, 6-8-1949.

SYNTHESIS OF ISO-OCTYL METHYL CYCLOPENTADIENE

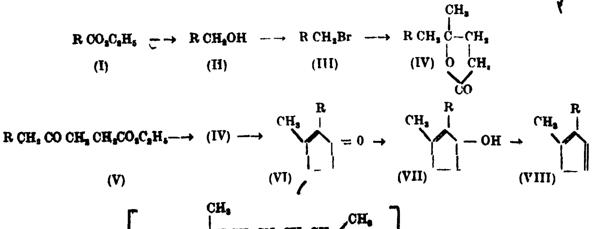
Synthesis of certain cyclopentane derivatives containing iso octyl side chain and the methyl group at the required positions and possessing some functional groups are of importance in the synthesis of steroid-like substances.

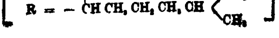
The synthesis of the following cyclopentenones appears to be of interest in this connection.



[A R = CH_3 R – iso octyl
VI R iso octyl R – CH_3]

Early attempts in synthesizing the ketone (A) through oxidation with selenium dioxide of the corresponding hydrocarbon failed.[1] Preliminary studies to build up similar cyclopentenone derivatives from 1:4 diketones proved futile.[2] Experiments have been undertaken to synthesize (VI) according to the interesting method developed for the preparation of substituted cyclopentenone through distillation of γ lactones with phosphorous pentoxide.[3] The required lactone has been synthesized in the following way. *Sec*-iso octyl-iodide is converted into cyanide which passes into ester (I) (80-85°/12 mm) directly on treatment with alcohol and sulphuric acid. Reduction of this ester with sodium and alcohol gives (II) (90-95°/18 mm) which on boiling with hydrobromic acid and sulphuric acid gives the bromide (III) (85°/18 mm). The Grignard's complex prepared from this bromide in presence of methyl iodide smoothly reacts with ethyl lavulinate in dilute ethereal solution at low temperature to give the lactone (IV 135-40°/6 mm) in a poor yield. A better method for the same lactone has been successfully carried out by employing the well known method developed by G. M. Robinson for the synthesis of long chain keto acids. The starting meterial for this synthesis is *sec* isooctyl acetic acid.[4] The acid chloride condenses with ethyl aceto succinate and the crude condensation





$$\left[\; R = -\overset{CH_3}{\overset{|}{C}}H\,CH_2\,CH_2\,CH_2\,CH\left\langle\begin{matrix}CH_3\\CH_3\end{matrix}\right. \;\right]$$

product is hydrolysed with alkali at the ordinary temperature[5] The keto acid is isolated as its ethyl ester (V) (130 32°/3 mm), which reacts smoothly with methyl magnesium iodide The desired lactone (IV) is obtained in a good yield on hydrolysis and subsequent lactonisation with dilute acid On distillation of the lactone over phosphorus pentoxide the cyclopentenone derivative (VI,126 30°/11 mm) is obtained in a moderate yield The structure of this ketone has been assigned on the basis of similar observations on the synthesis of dihydrojasmone from the lactone prepared from isohexyl iodide and ethyl lavulinate[6] and also from the later observations[7] where it has been definitely established that in the case of the γ lactones having a methylene group available for the formation of the cyclopentenone ring, the reaction proceeds always in the direction where only the methylene group is involved Reduction of the ketone with aluminium isopropoxide affords the unsaturated alcohol (VIII) This is converted into chloride with thionyl chloride in presence of pyridine and the chloro compound is heated with excess of dimethylaniline to give the doubly unsaturated compound (VIII) Attempts to introduce different groups at the methylene group through the potassium salt of cyclopentadiene (VIII) have met with failure so far

My grateful thanks are due to Dr P C Dutta for his kind interest and help in this this piece of work

PROVAS KUMAR DUTTA

Department of Chemistry
University Collegeof Science & Technology,
92, Upper Circular Road Calcutta
11 8 1949

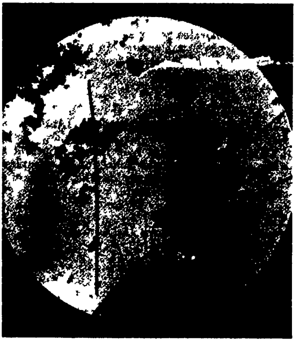
---

[1] Rydon *J Chem Soc* 1546 1940
[2] Mitter and Dutta *J Ind Chem Soc* 306 1948
[3] J Am *Chem Soc* 4 1944
[4] Dutta *J Ind Chem Soc* 78 1942
[5] Chuang et al *Ber* 1942, 1936
[6] *J Am Chem Soc* 4 1944 ,Dutta and Sengupta, *J Ind Chem Soc* 213 1948
[7] *J Am Chem Soc* 1379 1948

A CASE OF LARGE SCALE MORTALITY OF FISHES

Most cases of heavy mortality of fish, hitherto recorded, have been so sudden and unexpected that nothing could be done to prevent their occurrence But a large scale mortality which could have been avoided, by taking precautionary measures earlier, was observed on 10th February 1949 in the Poondi Reservoir, Madras Several tons of valuable food fishes were thus lost

The Poondi reservoir was constructed in 1944 by impounding the flood waters of the Kortalayar river for augmenting the city's water supply It has a total storage capacity of 26,000 million cubic feet and a waterspread of 12 6 sq miles at full tank level, and is being utilised since 1945 by the Fisheries Department for fish production In addition to local fishes, non-indigenous species such as *Catla catla* (Ham), *Labeo rohita* Ham , *Cirrhina mrigala* Ham , *Chanos chanos* (Forskal), *Mugil cephalus* (Forskal,) *Etroplus suratensis* (Bloch) and *Osphromenus goramy* Lacep , are stocked and conserved, and their fisheries exploited by a judicious system of licensing and departmental fishing During the summer (March to June) of 1946, the reservoir yielded nearly 67 tons of fish, and in 1948, 136 tons of fish were landed The last bumper fishery was also due to the unprecedented floods of December 1946 which brought the surplus waters and indigenous fishes of a number of irrigation tanks located in the catchment area into the reservoir After this fishery, the reservoir did not fill up to the normal level due to the failure of the north east monsoon during the year, which also impeded further stoking operations It was, however, expected that a fairly good fishery could be had during the summer of 1949 But, unfortunately, due to the failure of the monsoon rains, the level of water in the Red Hills reservoir became so low that the Irrigation Department had to deplete the waters of the Poondi reservoir in order to replenish it so as to meet the city water supply



Microphotograph of material choking gills and gullet of fishes of Poondi Reservoir

The way this depletion was accomplished appears to be mainly responsible for the large scale mortality At 6 P M on the 5th of February, when the depletion started the level in the reservoir was 119 7 feet On the 7th, at 12 noon, it was 115 0 feet, and on the 8th at 6 A M , 110 0 feet Then the weep holes in the baffle wall at the rear of the regulator were opened and water allowed to flow out suddenly, so that on the 9th at 6 A M the level went below that of the sill, and by the 11th there were only two small muddy puddles close to the regulator The fishery licencees consisting of 40 cast net operators and 1 drift net operator were allowed to fish as usual on the 8th From the 9th onwards, fishes showed acute signs of distress they gasped at the surface and a few dead ones were seen floating about 1800 lbs of them were caught and sold on the spot At about 12 noon, dead fishes were collected from inside and outside the baffle wall until 1 30 P.M , and thereafter fishing was done in the reservoir till 3 30 P M with cast nets and small bag nets Catches consisted mostly of big dead fish that had settled at the bottom About one ton were thus obtained and sent immediately to Madras in a specially chartered motor van Collection of the dead continued until 6 P M by sweeping the water surface with a net from a coracle On the 10th morning between 6 and 8 A.M , fishing with 16 bag nets in the baffle wall area alone resulted in a catch of about one ton of dead and dying, which was also sent to Madras Subsequently, cast nets were operated in the reservoir, where about half a ton of live fish was obtained On the whole a poor harvest of only 4 tons could be made as most of the fish died suddenly and putrified

Post mortem examination revealed that the gills and gullets of the dead fish were choked with mud filaments of *Oscillatoria*, and diatom frustules which were present in the phytoplankton of the reservoir The number of species that suffered this extensive mortality was over forty A portion of the mud clogging the gills was photomicrographed and confirmed the examination Chemical analysis showed that it contained silicious clayey matter

The hydrobiological conditions of the reservoir were studied both before and after the depletion Before depletion, the water was yellowish green, slightly turbid, highly alkaline and moderately saturated with dissolved oxygen The phytoplankton mainly consisted of three species of *Oscillatoria*, one of *Microcystis* one of *Euglena* and one of the diatom, *Nitzschia* After the sudden depletion it became muddy and contained a large amount of carbon dioxide, but little or no oxygen

TABLE SHOWING THE HYDROBIOLOGICAL CONDITIONS OF THE POONDI RESERVOIR BEFORE AND AFTER DEPLETION OF WATERS
(RESULTS EXPRESSED IN PARTS PER 100000)

No	Particulars	Before depletion	After depletion					
			From pool adjoining dam surface	From pool adjoining dam surface	From river below dam surface	From river below dam bottom (4)	From rear of dam baffle wall area surface	From rear of dam baffle wall area bottom (4)
1	Date	30-1 49	10 2 49	10-2 49	10-2 49	10 2-49	10-2 49	10-2-49
2	Time	5 30 P M	12 noon	12 noon	12 noon	12 noon	12 noon	12 noon
	[illegible]	Cloudy sky slight wind	Bright sun shine clear				blue sky	no wind
4	Turbidity (cm)	24 0	15 0	16 0	11 0	10 0	15 0	10 0
5	Colour	Yellowish green	dirty pale green	dirty pale green	pale green	pale green	dirty green	dirty green
6	Temperature (C)	26 6	30 5	28 6	28 0	27 0	28 6	26 6
7	Free CO_2	nil	0 1901	0 2534	0 1267	0 1267	0 2112	0 2534
8	CO_3	4 379	nil	nil	nil	nil	nil	nil
9	HCO_3	17 527	35 441	35 441	32 805	32 512	37 198	35 734
10	*p*H	8 6	7 85	7 80	7 9	7 85	7 9	7 85
11	Dissolved O_2 (cc/1)	2 583	1 466	0 5584	3 908	2 373	nil	nil
12	% of saturation	42 9	26 5	9 8	67 0	40 6		—
13	Chloride	6 00	10 00	10 00	10 0	10 0	9 5	10 0
14	Phosphate (P)	nil	0 1260	nil	nil	0 1376	0 1027	0 1363
15	Nitrates (NO_3 N)	nil	nil	nil	nil	nil	nil	nil
16	Silicates (SiO_2)	1 316	1 704	2 345	2 143	2 461	1 744	1 546
17	Phytoplankton	*Oscillatoria Microcystis Nitzschia & Euglena*						
18	Zooplankton	*Noteus sp , Diaptomus sp & Nauplius larvae*		—				

The sediments at the bottom were almost knee deep their disturbance by the fishermen had rendered the water very turbid, thus choking the gills and gullets of the fishes and reducing the oxygen content to the lethal limit

If the water had been let out gradually the entire fishery could have been exploited without mortality, and there would not have been loss of valuable fish food Now that multi purpose reservoirs are being constructed in various parts of our country, it is suggested that the several interests such as, irrigation electricity navigation and fisheries co operate with one another and frame co ordinated policies

We are grateful to Mr N V Choodamani Assistant Director of Fisheries (Inland) Madras and to Mr K P Thampan Assistant Inspector of Fisheries Poondi for giving us facilities for observation and to the Director of Industries and Commerce Madras for according permission for publication of this note

P I Chacko
S V Ganapati

Freshwater Biological Station
Kilpauk Madras 25 8 49

THE DONNAN MEMBRANE EQUILIBRIUM

The theory of membrane equilibrium was worked out first by Donnan in 1911 from ordinary thermodynamics[1] and later rigorously and comprehensively in collaboration with (Guggenheim)[2] from the conception of electro chemical potential introduced into thermodynamics by Guggenheim

In the rigorous as well as ordinary treatment the equilibrium has been considered between two phases of electrolytic solutions without the consideration of the non diffusible colloid or non diffusible aggregates of ions or molecules in one of the phases When the consideration of the non diffusible colloid or non diffusible aggregates of ions or molecules is not brought into the equilibrium the equilibrium considered becomes an equilibrium between two solutions of an electrolyte or electrolytes separated by a membrane through which the electrolytes are permeable the concentrations of the electrolyte or electrolytes or positive or negative ions resulting therefrom become equal and the relation of Donnan either simple or rigorous does not result In order to treat membrane equilibrium non diffusibility is to be considered and from this the relation between the concentrations of electrolytes in two phases is to be deduced Thus the development of the theory of membrane equilibrium by Donnan and Donnan and Guggenheim[2] does not appear to be correct

In reviewing my theory of the membrane equilibrium Donnan writes that employment of the Maxwell Boltzmann distribution theorem offers nothing new for the thermodynamic equations such as for example $N''\ N_1\ e^{x}$ are just examples of this theorem as applied to the special case considered
It follows from what has been stated before that in the case of membrane equilibrium the Boltzmann theorem cannot be deduced from thermodynamics employed by Donnan *et al* It is to be shown from thermodyanamics that the concentrations of the electrolytes in the two phases are related in definite ways by bringing in the condition of non diffusibility This however has not been developed by Dornan in the thermodynamics he employed. Hence my application of the Boltzman theorem to membrane equilibrium is a theory which cannot result from the thermodynamics developed up to the present time if we assume that Donnan's is the only treatment possible From the theory developed,by the author the equilibrium of a charged material (the condition being that the charged material is non diffusible) and a double layer in one of the phases with a solution of an electrolyte or electrolytes in the other phase gives the distribution law of Boltzman as the law of membrane equilibrium

In the case of colloidal solutions the colloidal particles with double layers form one of the phases and the back of the solution the other phase

S G Chaudhury

Department of Physical Chemistry
University College of Science & Technology
92 Upper Circular Road
Calcutta 8 10 1949

---

[1] *Z Electrochem* 17 57 1911

[2] Donnan *Z Physik Chem* *168* 369 1934 Donnan and Guggenheim *Z Physik Chem* *162* 346 1936

[3] Donnan Review on Chaudhury's The Donnan Membrane Equilibrium *Nature* April 20 1946

TRANSFORMATION OF BIGUANIDE INTO DICYANDIAMIDINE

The chemistry of biguanide and its complex compounds with metallic elements are being studied in this laboratory for over ten years In course of this investigation it was observed some two years back that certain substituted biguanides changed rapidly (within twelve to fifteen hours) in almost quantitative manner into a product with loss of one molecule of ammonia This change was investigated by me and the nature of the product studied The analytical result was found to correspond to that of the corresponding dicyandiamidine For the purpose of identification of the product I was engaged in synthesising the dicyandiamidine which the product was suspected to represent by various methods An attempt at synthesis by the condensation of Cyan Urea with the corresponding amines or by the hydrolysis of the corresponding dicyandiamide led however to no fruitful results While looking for other methods of synthesis I found recently in the July issue of the Chemical Society a paper by (the late) F H S Curd D G Davey and (Miss) D N Richardson on Synthetic Antimalarials Part XLII the preparation of Guanyl ureas and Biurets corresponding to Paludrine and related Diguanides[1] in which they have reported that when paludrine was kept in hydrochloric acid and set aside for one year a crystalline solid was deposited which they identified as the corresponding guanyl urea This was further confirmed by them by its synthesis from p chloro phenylisocyanate and Iso propyl guanidine They also synthesised the isomeric N p chloro phenyl N Iso-propyl guanylurea

I could not publish my observations earlier as I have been working for my Doctorate thesis I, now, find it necessary to publish this note giving a short sketch of the work which I have been carrying on It has been found that the change of aryl biguanide to the corresponding guanyl urea is considerably influenced by the nature and position of the substituents in the biguanide molecule N p sulphonamido and substituted N p-sulphonamido phenyl biguanide change most rapidly into the corresponding guanyl urea, whereas their N phenyl derivative remains practically unchanged

After submitting the thesis the details of my work will be published in due course

Palit Professor s Laboratory NAKULESWAR KUNDU
Chemistry Department
University College of Science & Technology
Calcutta 7 11 1949

J C S 1949 173

BOOK REVIEWS

Electricity and Magnetism—By M Nelkon M Sc (Lond), A K C Published in 1948 by Edward Arnold and Co London pp VII+431

The book deals mainly with the elementary principles of electricity and magnetism It contains twenty three chapters of which the first one gives an idea of the fundamental particles constituting the atom The second and third chapters deal with the elementary principles of electrostatics and electrostatic instruments Chapters four to seven are devoted to the principles of current electricity electrolysis and different type of cells etc The principles of magnetism magnetic effect of a current electromagnetic induction and properties of magnetic materials are given in chapters eight to thirteen Chapters fourteen and fifteen contain thermoelectricity units and dimensions of physical quantities Conduction of electricity through gases ions and electrons are given in chapter sixteen and the theory of alternating current in chapter seventeen Chapters eighteen and nineteen comprise the basic principle of thermionic values their various types and uses An outline of the theory of a cathode ray Oscilloscope is also given in this section

Elements of Radio activity elementary quantum theory, Bohr's theory of the atom are given in chapters twenty and twenty one The last two chapters deal with X ray and the principles of photo electricity

At the end of most of the chapters numerous questions have been set for the students to work out and the answers to these exercises are given at the end of the book

This text book is well written and beautifully illustrated It is meant for Intermediate Science students and those who want to sit for University Entrance Scholarship examination of Great Britain The B Sc, students of Indian universities will also be immensely benefitted if they read it

P C B

Roket Development, Liquid Fuel Rocket Research 1929-1941—By Robert H Goddard, Ph D Sc D Prentice Hall Inc 70 Fifth Avenue New York 11, N Y Cloth, 6″×9″, pp xx+291, 1948 Price $ 6 50,

The scientific study of rockets started at the beginning of this century was brought into prominence by men like Ziolkowsky and Rynin of Russia Oberth Valier and Opel of Germany Robert Esnault Peltérie of France and Goddard of America These men saw in the rocket its great possibilities as a means for attaining extreme altitudes and for space travel Among these pioneers the work of Dr Robert H Goddard was pre eminent Although the basic idea of utilising the rocket principle to attain very high altitudes was conceived in the middle of the 18th century Dr Goddard conducted the first scientific experiments and his report published by the Smithsonian Institution Washington (A method of Reaching Extreme Altitudes Pub 2540 1919) was the first scientific publication on this subject Some 16 years later another publication on liquid propellant rockets was released by him as Smithsonian Inst Pub 3381 1936 In fact these two reports together with some 60 patents was all that emanated during the entire creative period of this eminent scientist It is therefore quite exhilarating to find that two of his most intimate workers *viz* Ester C Goddard (who is Dr Goddard s wife and was formerly his secretary) and G Edward Pendray took pains to accumulate the notes and finding and publish them in this book Dr Goddard s work from 1929 to 1942 clearly reveal his pioneering instinct in the development of liquid fuel rockets He anticipated many developments now visible in the guided missile field such as steering of the rockets in flight by vanes in the jet propulsion units utilising atmospheric air akin to ram jet and pulse jet gyroscopic stabilization ideas of step rockets and shooting of a rocket at supersonic speed

It is very gratifying to learn that in addition to the publication of this book two new chairs in Jet Propulsion have been established at Princeton University and California Institute of Technology mainly through the efforts of the Daniel and Florence Guggenheim Foundations to perpetuate the memory of Dr Goddard

Thus this book forming a valuable historic record of the pioneering developments of Dr Goddard together with the establishment of the two chairs form a fitting and worthy memorial for this great American aeronautical savant

S K G

A Text Book of Radar—a Collective work by the staff of the Radio-Physics Laboratory Council for Scientific and Industrial Research Australia Pages 579 Publishers Aungus and Robertson

The book under review is a collective work by the staff of the Radio Physics Laboratory of the Commonwealth Scientific & Industrial Research Organisation of Australia This laboratory was established in 1939 as a centre of radar research and development for the Allied Forces in the Pacific area The knowledge of radar techniques thus gained during the war has been compiled in a compact form to be readily available to physicists and engineers interested in the latest developments of microwave techniques

The book contains twenty chapters The introductory chapter gives a short but interesting account of the historical development and applications of radar The second chapter on Fundamentals begins with a description of the components of a radar set and gives a clear idea of the echoing process which is the basis of the success of radar Some fundamental concepts such as echo cross section aerial gain absorption cross section etc have been defined in this chapter The effect of the presence of the earth on free space propagation of radar waves and also the phenomena of normal refraction super refraction atmospheric absorption and scattering have also been briefly discussed

Magnetrons have been dealt with in Chapter III but on reading it one is left with the impression that the treatment has been somewhat brief with the result that the principles involved in the magnetron could not have been as fully explained as one would like even in a text book like this

This next chapter on triode power oscillators is unduly small and discusses very briefly the electrical and physical design of troide oscillators for pulsed operation in the vicinity of 500 megacycles per second This is followed by a chapter on modulators which contains fairly detailed treatment of various types of modulators and modulator circuits The section on pulse transformers gives many useful practical details

The next three chapters deal with microwave transmission and cavity resonator theory transmission line and resonator techniques and aerials and cover 185 pages of the book These chapters embody the latest developments in microwave technique and the treatment shows commendable balance between mathematical analysis and practical details

A separate chapter is devoted to aerial duplexing giving details of the arrangements for using the same aerial both for transmitting and receiving pulsed signals

Chapter X on receivers serves as an introduction to a more detailed treatment of receiver principles involved in radar systems given in the following three chapters These include discussions on local oscillators particularly the operation and function of klystrons frequency converters and amplifiers

The next two chapters deal with the principles and applications of display circuits and automatic ranging circuits Chapter XVI on radar systems explains briefly the design specifications of a radar set as divided into the functional and the operating characteristics The next three chapters describe the design features and applications of Ground Radar Shipboard Radar and Airborne Radar The last chapter on radar navigation discusses the military uses of radar for navigation and the application of navigational aids provided by the radar technique to civil aviation The book contains a number of useful tables curves and is fairly well illustrated including a collection of 31 plates

The subject treated in the book is vast and is mostly based on very recent developments and inventions In fact the contents of each chapter of the book may easily provide material for a big treatise and such treatises have already been in the market The effort that the staff of the Radio Physics Laboratory has made in condensing such a vast subject within the compass of 579 pages is really commendable All the chapters are written in good simple style and it is believed that the book will prove to be of much help as a text book to students and teachers alike *J N B &*
S S

Study of Mine-Surveying—Vol. 1—By S K Dhar Published by the Film Press Calcutta To be had from The Sketch Press Dhanbad or Das Gupta & Co College Street Calcutta Price Rs 8

Mr Dhar s attempt to write a book on the different mine surveying methods is somewhat new in this field of science Uptil now we had to depend on the imported books written in English and moreover these books usually deal with the surveying problems concerning their own country which is quite different from the practice commonly followed in this country Mr Dhar has tried his best to tackle the complicated problems of underground surveying which are usually encountered in this country The book is written in a very easy language which can be understood by a student of surveying with a working knowledge of English The several chapters at the beginning give us an idea of the fundamental principles of surveying and the preliminaries of elementary geology which are essential for a competent surveyor of a mining concern The remaining chapters deal with the advanced knowledge and application of the surveying principles for solving complicated mining problems such as tracing of fault planes in a mine etc

On the whole the book seems to be very useful not only to the mine surveyors but also to the students of the Mining School and to the students of the evening mining classess

The price of the book is also very reasonable which seems to be within the limit of the class of people who usually take up the profession of mining in any capacity in this country

S D

VOL. 15 JANUARY 1950 No 7

UNIVERSITY EDUCATION COMMISSION 243
Recommendations of the University Education Commission 1948 49 246
Training in Chemical Engineering at the M I T—
Bazle Karim and Tuhin K Roy 258
Synthetic Food Production—*M N Krishnamurti* 261
Control of Rust Epidemics of Wheat in India
—A National Emergency—*K C Mehta* 263
W F Giauque—*A B* 271
NOTES AND NEWS 271

LETTERS TO THE EDITOR

Industrial Wastes Disposal—Treatment and Utilization of Textile Wastes—*S Balasundaram and V Subrahmanyan* 277
Oscillations of a Convex Lens on a Plane Smooth Surface—*V L Tilekar* 279
The Chromosome Number and the Development of the Embryo Sac in *Crotalaria Intermedia* Kotschy—*A K Paul and R M Dutta* 280
A Note on the Bionomics of *Lepidocephalus Thermalis* (Cuv and Val)—*P I Chacko* 281
A Chamber for Phytohormone Researches in the Tropics—*S M Sircar and T M Das* 282
Rickettsiosis in Indian Sheep—*H N Ray* 284
The Role of Dark Coloured Fungi in the Micro biological Deterioration of Sun exposed Jute Fabric—*S N Basu and S N Ghose* 285
BOOK REVIEWS 286
INDIAN SCIENCE CONGRESS SUPPLEMENT following P. 290
Poona
Life Sketches of General and Sectional Presidents

The annual subscription to the journal is Rs. 10/ (inland) £ 1 or $4 00 (Foreign) Ordinary Membership fee for the Association is Rs 15/ (£ 1 10s or $ 5 00) per year which covers the subscription of the journal. A person or a Corporation paying Rs. 150/ (£ 12 or $ 48.00) shall be eligible for a Life Membership of the Association and will be entitled to a copy of the journal every month

The Indian Science News Association and the Editors of 'SCIENCE AND CULTURE assume no responsibility for statements and opinions advanced by contributors to this Journal.

All MANUSCRIPTS should be legible and typewritten. The Editors reserve to themselves the right to accept or reject the whole or portions of the matter sent for publication. The rejected contributions are not returned to authors, if postage is not prepaid

Remittances for membership dues, subscription and advertisement costs should be addressed to the TREASURER, INDIAN SCIENCE NEWS ASSOCIATION, at 92, Upper Circular Road, Calcutta, 9

Editorial communications are to be addressed to the Editor and other communications to the Secretary, Indian Science News Association, both at 92 Upper Circular Road, Calcutta, 9

SCIENCE AND CULTURE

A Monthly Journal of Natural and Cultural Sciences

Published by the
INDIAN SCIENCE
NEWS ASSOCIATION

Editor
D M Bose
S K Mitra A C Ukil
P Ray S N Sen

Associate Editors
A K Ghosh
R Chatterjee B Mukherjee

Collaborators
S P Agharkar Atmaram
G C Mitra K G Bagchi
A C Banerjee K Banerjee
S K Banerjee K P Basu
D N Wadia K V Giri
H P Bhaumik K Biswas
N N Chatterjee N K Bose
D Chakravarti N R Dhar
S C Chatterjee J C Saha
S P Chatterjee A C Joshi
N N Dasgupta S L Hora
G J Fowler N R Sen
S S Bhatnagar H P Maity
P C Mahanti B Mukerji
S C Mitra S R Palit
J N Mukherjee N C Saha
Kamalesh Ray B B Sarkar
S K Ghaswala J M Sen
V Subrahmanyan S N Sen
B C Kundu S. C Sirkar
S S Sokhey J N Bhar
Maneck B Pithawalla
K. P Chattopadhyay
S P Ray Chaudhury
H K Mookherjee
Surendra Nath Sen

Editorial & Publication Offices
92 Upper Circular Road,
Calcutta 9

Advertising Office
92 Upper Circular Road
Calcutta 9

LET US HELP YOU

IN OBTAINING

ALL YOUR LABORATORY EQUIPMENT

WE SPECIALISE IN

SCIENTIFIC APPARATUS

OF ALL KINDS

ALSO

ACIDS, SOLVENTS & OTHER CHEMICALS OF REAGENT QUALITY

OUR PATRONS INCLUDE REPUTED TECHNICIANS IN VARIOUS INSTITUTIONS AND INDUSTRIAL CONCERNS THROUGHOUT THE COUNTRY

ENQUIRIES RESPECTFULLY SOLICITED

Bengal Chemical

& PHARMACEUTICAL WORKS LTD.

94, CHITTARANJAN AVENUE, CALCUTTA 12.

SCIENCE AND CULTURE

A Monthly Journal of Natural and Cultural Sciences

Vol. 15 JANUARY 1950 No. 7

UNIVERSITY EDUCATION COMMISSION

All sections of the public interested in the advancement of education of the country have heartily welcomed the publication of the report of the University Education Commission, eagerly awaited ever since Dr Sarvapalli Radhakrishnan, the Commission's chairman, submitted the report to the Government on August 25, 1949 and left for Moscow to take up his new responsibilities as India s ambassador to the U S S R The chairman, before his departure for the Soviet capital, did indeed hold a press conference in which he gave a bare and necessarily incomplete outline of some of the recommendations This, it is needless to say, hardly satisfied the public curiosity to know, in reasonable details the findings and recommendations on the wide and varied aspects of the country's higher education and research, both general as well as professional, which stood referred to the Commission

The Commission were appointed in November 1948 by a special resolution of the Ministry of Education They had wide terms of reference which ranged from an analysis and re evaluation of the aims and objects of university education and research in the light of present national and international set-up to detailed investigations into such questions as the discipline of students, students' accomodation and organization of tutorial work The Commission were asked to make comprehensive enquiry into, and recommendations on, the constitution, control, functions and jurisdiction of universities and their relations with Provincial and Central Governments, university finances, maintenance of the highest standards of teaching and examinations, balanced curricula, standards of admission, medium of instruction and the language question, teachers' qualification and emoluments etc. In fact, there was hardly any aspect of university education and research which remained outside the scope of their enquiry

The Commission s report comprising 744 pages was in the government hands by the end of August 1949, that is within less than nine months of the commencement of work During this period they had examined the working of over 23 universities and a large number of their affiliated colleges, and also visited several research and technological institutes and learned societies About 2900 copies of a comprehensive questionnaire were circulated to premiers, education ministers, directors of public instruction, vice chancellors and heads of educational institutions, members of the Constituent Assembly educationists, publicists and prominent men throughout the country

The speed and record time in which this vast and difficult undertaking was accomplished fully reflects to credit of those able educationists, scientists, engineering and medical specialists and the three foreign experts who comprised the Commission * The Sadler commission which were appointed to examine the working of one single university, *e g*, the Calcutta University, required two years to conclude their report

It is of great significance that, in laying down the aims and objectives of higher education in India, they went straight into the question of the social order for which the country must educate her youth "Our educational system", the report emphasized, "must find its guiding principle in the aims of the social order for which it prepares, in the nature of the civilization it hopes to build Unless we know whither we are tending, we cannot decide what we should do and how we should do it Societies like men need a clear purpose to keep them stable in a world of bewildering change" Naturally enough the Commission kept in view the conception of a

---

*For the personnel of the Commission, see *Science and Culture*, 14, 241, 1948.

free democratic society as indicated in the preamble of the Draft Constitution for India based on the inherent worth of the individual on the dignity and value of the human life and on social economic and political justice on liberty of thought expression belief faith and worship on equality of status and opportunity and on universal fraternity—in short on the ideals laid down for future India as a free secular democratic State

Admittedly this can be the only *raison d être* of university education in India Fully conscious of the indispensability of pursuing the methods of higher education and research such as have proved sucessfull in the Western countries the Commission were equally alive to the supreme need of orienting the present educational system in order that it might be representative of what is best in the culture philosophy history and thought of this ancient people Only by such happy balance between the two dominant eastern and western cultures can the highest aspirations of the people of this subcontinent find perennial expression through education

We propose to take up the various findings and recommendations of the commission in a series of articles beginning with the most important recommendations bearing on relations and spheres of cooperation between the Centre and the Provinces and States in the future educational development of the country

I THE PRINCIPLE OF CONCURRENCY—THE UNIVERSITY GRANTS COMMISSION

Any practical recommendation for a unified development of university education in this subcontinent must first of all deal with the question of relationship and the extent of co operation between the Centre and the Provinces The Commission have very wisely decided against the two extreme and opposing schools of thought which would like to see the university education a wholly provincial subject or wholly a concern of the Central Government In conformity with the views expressed by the vast majority of witnesses* the Commission have recommended the Principle of Concurrency on which to base future educational planning which broadly implied that while the initiative administration and in many fields of activity final responsibility should rest with the Provinces States or Unions the Centre should have co ordinating power in respect of ensuring a minimum standard of teaching and education the development of an over all common national policy and objective and joint planning by Provinces States and Unions whenever necessary Wihin these general categories the Centre should specially concern itself with finance co ordination of facilities in special subjects liaison between universities and national research laboratories scientific surveys etc adoption of national policies and minimum standards of teaching and efficient management

Burdened with heavy commitments in regard to the extension of basic secondary and technical schools the Provinces—the Commission have correctly diagnosed are simply not in a position to bear the whole of the expenditure on university education The Centre has an inescapable responsibility in the matter of strengthening the financial resources of the "universities to meet urgent needs for more buildings more and better paid staff more scholarships more facilities for research etc" The Commissions recommendation that all universities should not be encouraged to take up teaching and research in subjects of very specialized character but that such work should be undertaken after very careful consideration of the full range of facilities available at a particular university or universities and of the question of duplication is very important* This is all the more urgent in view of the limited finances which would be better spent on a carefully worked out concentrated project at one place rather than dissipating them over a number of like projects at different universities either for reasons of satisfying all groups or for political and provincial considerations Such short sighted tendencies are often at work and it would be the Centre s main responsibility to counter such forces and tendencies in the best interest of the nation as a whole

THE UNIVERSITY GRANTS COMMISSION

The principal instrument through which to exercise the co ordinating functions of the Centre will be the University Grants Commission (UGC) of which the nucleus was formed when the University Grants Committee were created in 1945 to deal with the three Universities of Aligarh Benares and Delhi sometimes known as central universities because they are regarded mainly as the concern of the Centre The Committee s work was later on extended so as to include other universities under their sphere of activities We have already fully discussed (*Science & Culture* January 1949) the history composition and working of this committee As we have pointed out there the Grants Committee apart from making useful recommendations occasionally did not on the whole appear to have a successful career on account of a variety of factors First their composition was faulty for unlike the corresponding British body it had

(1) No whole time workers except a secretary,

(2) The members were all honorary and met only for a few hours to transact a huge amount of business

(3) The members were selected on considerations other than educational and the majority had no first hand knowledge of university matters

Secondly unlike the British U G C which is a committee of the Treasury and receives a grant directly from the Parliament with powers to spend it on its sole responsibility without further reference to any other ministry, the Indian Grants Committee were merely a committee of the Ministry of Education They had powers only to make recommendations for grants to the Ministry of Education which had the option to transmit them often in a highly processed and distorted form, to the Finance Ministry The Finance Ministry of the Government of India is a sort of super ministry for except for transport and defence every new item of expenditure proposed in the budget of any other ministry has to be passed by this super ministry, and most of the new projects frequently get choked up in the finance archives The result was that hardly any recommendation of the old university Grants Committee went through unless the initiator happened to be a man of extraordinary energy

---

*In fact, there was only one solitary witness who advocated complete control of the university education by the Provinces a very large number of witnesses, however advocated complete control by the Centre.

*Even in the United Kingdom which is a very rich country teaching and research in Nuclear Physics, which is a very expensive subject is confined only to 6 of 21 universities.

Notwithstanding these inherent disabilities the principle behind the university Grants Committee was sound and the need for its creation indispensable The Commission have attached fundamental importance to such a central agency for allocating grants and even remarked that if it were not in existence we should have had to invent it In putting forward their proposal for a new University Grants Commission (UGC) they have sought to remove the two fundamental and paralyzing defects of the old Committee relating to the question of composition and of the power of allocating grants

The UGC the Commission have emphasized should be an expert body in the strictest sense of the term as rigidly protected from political or personal lobbying and pressure as the constitution of the country can make them They recommended a small body composed of three to five full time members appointed by the Government one of them to be chairman and the two Secretaries of the Ministries of Education and Finance The members should be men of high academic standing wisdom and integrity with at the same time first-hand knowledge of university affairs and should have a term of office for six years To ensure the strictly non political character of the UGC it is suggested that the members should have responsibility comparable to that obtaining in the Federal Public Service Commission and should be debarred from subsequently holding any university office A special importance attaches to the Commission s view that in a UGC of three non official members at least one should be a scientist and another a humanist This will introduce the desirable balance of interest ' If the UGC be composed of five non official members we would suggest that in view of the growing national need for scientific education and research, two of them should be scientists one a humanist and the remaining two men of arts and letters or of law, history, economics and sociology

The conception of full time paid members is in accordance with the composition of the University Grants Committee of Great Britain The British Committee is composed of a professional chairman a deputy chairman, a secretary who are all full time and a small office staff Besides there are fourteen members who serve in an honorary capacity, being paid modest fees for time spent The terms of reference of the Committee were "to enquire into the financial needs of university education in the United Kingdom and to advise the Government as to the application of any grants that may be made by the Parliament towards meeting them ' Sir William McCornick was its first chairman and other members included such notable educationists and scientists as professor William Bateson Sir William Bragg Sir Arthur Keith, Sir Frederic Kenyon Sir George Macdonald, Sir Humphrey Rolleston Sir J J Thomson and Sir Henry Tizard There has always been one women member The committee set up a number of Sub committees on specific subjects such as medicine argiculture, the social studies, buildings etc

To facilitate the representation of all educational interests in the normal working of the UGC, the Commission have proposed that the UGC should he helped by as in the case of the British UGC a number of expert panels in each subject or group of cognate subjects each under a chairman These panels should consist of people having intimate knowledge of teaching and research in that particular field and should include university professors The members should work in an honorary capacity, being paid only their expenses when they attend meetings or visit universities To secure closer integration of work between the UGC and the panels, at least one of the full-time members of the Commission should attend the meeting of each panel For a large country, this system of working through panels has much to recommend itself and we are confident that the plan will work provided adequate resources are placed at their disposal

As pointed out before the allocation of grants from the Central Treasury for educational and research purposes will be the principal duty and responsibility of the UGC The total amount to be made available for disbursement needs must be decided by the Parliament but after this amount has been voted, the UGC will have the fullest power for detailed allocation of the grant without any further reference to either the education or the finance minister This power is calculated to accord to the UGC a prestige and effectiveness as an instrument which its predecessor sadly lacked

The Commission have laid great emphasis on the Centre s responsibility for advanced research and teaching and strongly recommended that the Centre should bear 50% of the cost of post graduate and research work This means a doubling of the financial resources at present available for higher university study, and not that the Government of India should relieve these Provinces by half their present expenditure of such work ' Moreover, the recurring grant is proposed to be made on a steadily expanding scale so as to leave room for natural expansion and development of higher studies In the words of the Commission, "Instead of giving a large sum in a good year and cutting it down in a bad year, it would be well for the Government to fix the sum at a figure that they feel confident of being able not merely to maintain but to increase by some small percentage annually for, say, the next ten years." The Commission has also clarified the idea behind recurring grants as signifying that such grants should be subsequently considered as part of the regular general income of the university on the implicit condition that these should be spent exclusively on advanced research and teaching and should under no circumstances be diverted for expenditure on the lower stages of the university degree.

It is well to consider the proportion of the annual income of the British universities, received from public funds. Until fairly recently, one third of the income of the universities in Britain was derived from fees, one third from endowments and one third from public funds, local and central. Thus, in 1920-21, the university bodies received 29% of their annual income directly from the Treasury. But with the increased demand for university education, rise in the student population, and much higher cost of research, specially scientific research, the universities have come to depend more and more on the Treasury grants. In 1945-46, the Treasury grants amounted to 44 per cent of the total university receipts, and 60 per cent in 1947-48, and are expected to rise to 65 per cent in 1951-52. The recurring annual grant which the government disbursed through the U G C increased from £ 800,000 in 1920-21 to £ 9,000 000 in 1948 and may rise still further to £ 12,000,000 in 1951-52.

The Ministry of Education, albeit an important source, is by no means the only source of grants to the universities. Other ministries such as the Ministries of Agriculture, Health, Department of Scientific Research, etc. make substantial grants to the universities and research institutions to foster the study of subjects in which they are directly interested. These ministries may prefer to retain their privilege—may be it is a necessity—of making independent grants. The suggestion to canalize all ministerial or departmental grants intended for universities through the U G C might appear to be over simplified, but that effective co-ordination between the U G C and other ministries choosing to disburse grants independently is clearly necessary and is indisputable. On this question the Commission's view is that these ministries will find it to their advantage to use the U G C as their recommending agent for the allocation of such grants. They have not gone further than this mild statement. In our opinion, the Commission should have clearly suggested that the U G C should be consulted and their recommendations sought on all cases of such departmental grants before taking any final decision. Failing such an understanding, there is danger of duplication in the allocation of grants.

Should the U G C have any other duties besides the allocation of grants? In the opinion of the Commission, they should not have any. The Commission maintain and rightly, that even to carry out this duty successfully the U G C will have to perform a variety of other related duties including regular and periodic visits to the universities and the maintaining of lively touch with university affairs. For instance the charter for the creation of new universities can only be given by the Centre, on the recommendation of the U G C. This is a very important question and the Centre should have final responsibility and authority in this matter, as otherwise it will be difficult to prevent the growth of mushroom universities and teaching organizations which grant degrees for money as in some countries. Besides the U G C should be always available for consultation and advice. This in itself will be sufficiently heavy and onerous to keep the Commission busy all the year round. The point is that only time and experience can show in what other ways the U G C's services may be best utilized to further the educational and research interests of the country.

In the subsequent issues, we propose to deal with the other recommendations of the Commission.

RECOMMENDATIONS OF THE UNIVERSITY EDUCATION COMMISSION, 1948-49*

CHAPTER II

SUMMARY

Democracy depends for its very life on a high standard of general, vocational and professional education. Dissemination of learning, incessant search for new knowledge, unceasing effort to plumb the meaning of life, provision for professional education to satisfy the occupational needs of our society are the vital tasks of higher education.

There must be sufficient unity of purpose in all this diversity to produce a community of values and ideas among educated men. Our policies and programmes must be brought into line with the social purposes which we profess to serve. We may use various institutional forms as time and circumstances may require but we must be steadfastly loyal to the abiding elements of respect for human personality, freedom of belief and expression for all citizens, a deep obligation to promote human well being faith in reason and humanity.

The greatness of a country does not depend on the extent of its territory, the length of its communications or the amount of its wealth, not even on widespread education or equitable distribution of wealth important as all these things are. If we wish to bring about a savage upheaval in our society, a raksasa raj all that we need to do is to give vocational and technical education and starve the spirit We will have a number of scientists without conscience technicians without taste who find a void within themselves a moral vacuum and a desperate need to substitute something anything for their lost endeavour and purpose Society will then get what it deserves If we claim to be civilised we must develop thought for the poor and the suffering chivalrous regard and respect for women faith in human brotherhood regardless of race or colour nation or religion love of peace and freedom abhorrence of cruelty and ceaseless devotion to the claims of justice

---

* Published by the Manager of Publications, Government of India, Delhi, 1949

We cannot preserve real freedom unless we preserve the values of democracy justice and liberty equality and fraternity It is the ideal towards which we should work though we may be modest in planning our hopes as to the results which in the near future are likely to be achieved Utopias are sweet dreams wrote Kant but to strive relentlessly toward them is the duty of the citizen and of the statesman as well Universities must stand for these ideal causes which can never be lost so long as men seek wisdom and follow righteousness

Our Constitution lays down the general purposes of our State If we are to make the understanding and vision of our farsighted and sensitive leaders who framed the Constitution the common possession of all our people our universities must educate on the right lines and provide proper facilities for educating a larger number of people If we do not have the necessary intelligence and ability to work out these purposes, we must get them through the universities What we need is the awareness of the urgency of the task the will and courage to tackle it and a wholehearted commitment of this ancient and yet new people to its successful performance

CHAPTER III

We recommend —

(1) That the importance of the teacher and his responsibility be recognised
(2) that conditions in universities which are suffering from lack of finances and consequent demoralization be greatly improved
(3) that there be four classes of teachers Professors Readers Lecturers and Instructors
(4) that each university should have some Research Fellows
(5) that promotions from one category to another be solely on grounds of merit
(6) that the scales of salaries for university teachers be

Professors	Rs 900 50 1 350
Readers	Rs 600 30 900
Lecturers	Rs. 300 25 600
Instructors or Fellows	Rs 250
Research Fellows	Rs 250 25 500

(7) that the scales of salaries for affiliated colleges with no post graduate classes be—

Lecturers	Rs 200 15 300 20 400
Senior posts	Rs 400 25 600 (two in each college)
Principals	Rs 600 40 800

that for colleges which have post graduate classes the grades be—

Lecturers	Rs 200 15 300 20 400 25 500
Senior posts	Rs 500 25 800 (two in each college)
Principals	Rs 800 40 1 000

(8) that care be taken for the selection of proper teachers
(9) that the proportion of junior posts (Lecturers and Instructors) to senior ones (Professors and Readers) be roughly 2 1
(10) that age of retirement be ordinarily 60 but extensions be allowed up to 64 in the case of a Professor
(11) that conditions regarding Provident Fund leave and hours of work be definitely laid down

CHAPTER IV

We recommend —

(1) that the standard of admission to the University courses should correspond to that of the present intermediate examination i e after the completion of 12 years of study at a school and an intermediate college
(2) that in each province a large number of well equipped and well staffed intermediate colleges (with classes IX to XII or VI to XII) be established
(3) that in order to divert students to different vocations after 10 to 12 years of schooling a large number of Occupational Institutes be opened
(4) that refresher courses be organized by the universities for high school and intermediate college teachers
(5) that to avoid overcrowding at universities and colleges the maximum number in the Arts and Science faculties of a teaching university be fixed at 3 000 and in an affiliated college at 1 500
(6) that the number of working days be substantially increased to ensure a minimum of 180 in the year exclusive of examination days with three terms each of about 11 weeks duration
(7) that lectures be carefully planned and supplemented by tutorials library work and written exercises
(8) that there be no prescribed text books for any courses of study
(9) that attendance at lectures be compulsory for undergraduate students as at present and that private candidates of only certain categories be allowed to appear for public examinations An experiment should how

ever be made with evening colleges for working people

(10) that tutorial instruction be developed in all institutions imparting university education in the following manner —

(a) students should report to tutors in groups not exceeding 6 in number

(b) tutorials should be made available to all undergraduates both pass and honours

(c) tutorials should stimulate the mental development of students and should not become mere coaching for examinations

(d) if tutorials are to succeed the teaching staff should be improved in quality and quantity

(11) that university libraries be greatly improved by —

(a) larger annual grants

(b) the introduction of the open access system

(c) longer hours of work

(d) better organization and

(e) a well trained staff which should include reference assistants

(12) that the laboratories be improved in buildings fittings equipment workshops and technicians

CHAPTER V

We recommend —

(1) That students be admitted to colleges and universities in the faculties of arts and sciences and to such professional schools as do not require more advanced preparation after successful completion of twelve years of schooling or its equivalent that is after they have passed the qualifying test which will correspond to the present intermediate standard

2 that the Master s degree be given to honours students after one year of study beyond the bachelor s degree and to pass students after two years beyond bachelor s degree

3 that both universities and secondary schools begin study of the theory and practice of general education and undertake preparation of syllabuses and reading matter somewhat after the manner outlined in this section that studies be made by individuals and by educational groups in various fields and that literature for general education course be developed which will give the student the best possible acquaintance with and mastery of the contents and methods of thinking and working in each field and with the relations of related fields—this without requiring more than a fair share of the student s time,

4 that without unnecessary delay the principles and practice of general education be introduced, so as to correct the extreme specialization which now is common in our intermediate and degree programmes

(5) that the relations of general and special education be worked out for each field keeping in mind the general interests of the student as a personality and a citizen and his special occupational interests

CHAPTER VI

We recommend —

(1) that there should be a uniformity in the regulations for the M A and M Sc degrees A pass graduate should study for at least two years and an honours graduate for at least one year teaching for these degrees should be properly organized by means of regular lectures seminars and laboratory work The course should include advanced study of one special subject and training in methods of research but not actual research Admission to these courses should be on an all India basis at every university There should be the closest presonal touch between staff and the students

(2) that the training for the Ph D degree should extend over a period of at least two years A Ph D student should not become a narrow specialist but his grasp of his subject should be characterized both by breadth and depth The examination should include a thesis and a viva voce examination to test the candidate s general knowledge of the whole field of the subject Admission to Ph D courses should be made with great care and should be on an all India basis

(3) that teaching universities should develop research training in as many branches of knowledge as they can while the affiliating universities should develop postgraduate and research departments in subjects in which they can secure services of scholars of high quality

(4) that there should be a certain number of Research Fellowships in each university for students who have taken the Ph D degree and wish to pursue a career of scholarship and research These Fellowships should be awarded only to those Ph Ds who have shown a high degree of scholarship and competence for research ,

(5) that the D Litt and D Sc degrees should be awarded on published work of outstanding quality and conspicuous originality ,

(6) that university teachers should give the community punctuality, efficiency and devotion to duty in relation to their teaching work, and new ideas and newer methods in relation to their research work ,

(7) that the ample resources available in our country for research in languages and literature classical and modern as also in Philosophy Religion History and Fine Arts should be properly utilized by scholars

(8) that as there is an acute shortage of scientific man power and is at its worst so far as it concerns teachers in science where it is much more qualitative than quantitative it is desirable to train a large number of scientists in the hope that we may get a few men of outstanding calibre

(9) that the Ministry of Education should institute a large number of scholarships and free places for really good students at the M Sc and Ph D stages There should be a suitable machinery for the selection of students for these scholarships and free places which should function as a body for science talent search

(10) that the teaching personnel of the scientific departments of universities should be strenghtened by the creation of additional professorships readerships and lecturerships In selecting the personnel empasis should be on quality rather than on numbers

(11) that fundamental research should be the primary concern of the universities and universities should not be precluded from taking up special applied problems concerning their own regions

(12) that generous capital and maintenance grants should be made to the scientific departments of universities to enable them to extend and consolidate their post graduate and research facilities as has been done in Great Britain where the maintenance grants have recently been trebled

(13) that in order to make up the serious deficiency in biological teaching and research in our universities we should have five marine biological stations The scope of the Central Fisheries Station at Mandapam should be enlarged so that it can function as a Marine Biological Station in the largest sense Further the universities of Bombay Andhra Madras and Travancore should be given capital and maintenance grants to conduct teaching and research in marine biology more effectively as well as to cater for the needs of inland universities All these five stations should organize six to eight weeks courses in systematic marine zoology to start with and then add courses in comparative physiology and experimental zoology and general and experimental embryology They should also maintain supply departments for the supply of marine biology material to inland universities

(14) that greater facilities should be provided for study and research in border line sciences like Biochemistry Biophysics Geo chemistry Geo physics etc

CHAPTER VIII

We recommend —

(1) that all educational institutions start work with a few minutes for silent meditation

(2) that in the first year of the Degree course lives of the great religious leaders like Gautama the Buddha Confucius Zoroaster Socrates Jesus Samkara Ramanuja Madhava Mohammad Kabir Nanak Gandhi be taught

(3) that in the second year some selections of a universalist character from the Scriptures of the world be studied

(4) that in the third year the central problems of the philosophy of religion be considered

CHAPTER IX

We recommend —

1 that the Federal Language be developed through the assimilation of words from various sources and the retention of words which have already entered into Indian languages from different sources thereby avoiding the dangers of exclusiveness

2 that international technical and scientific terminology be adopted the borrowed words be properly assimilated their pronunciation be adapted to the phonetic system of the Indian language and their spelling fixed in accordance with the sound symbols of Indian scripts

3 that for the medium of instruction for higher education English be replaced as early as practicable by an Indian language which cannot be Sanskrit on account of vital difficulties

4 that (i) pupils at the Higher Secondary and University stages be made conversant with three languages —the regional language the Federal language and English (the last one in order to acquire the ability to read books in English) and

(ii) Higher education be imparted through the instrumentality of the regional language with the option to use the Federal language as the medium of instruction either for some subjects or for all subjects

5 that for the Federal language one script Devanagari be employed and some of its defects be removed

6 that immdiate steps be taken for developing the Federal and Regional languages

(i) A board consisting of scientists and linguists be appointed to prepare a scientific vocabulary of words which will be common to all

Indian languages and also to arrange for the preparation of books in different sciences to be rendered into all Indian languages

(ii) Provincial Governments be required to take steps to introduce the teaching of the Federal language in all classes of Higher Secondary Schools in Degree Colleges and in Universities

7 that English be studied in High Schools and in the Universities in order that we may keep in touch with the living stream of evergrowing knowledge

CHAPTER VII

Agriculture

Nearly three quarters of our people are engaged in agriculture In the past this part of our population has been too heavily burdened by taxation and by other exactions and has received too small a share of the national income As a result rural India as a whole is in deep poverty and illiteracy The national supply of food and fabric which depends upon agriculture is precariously insufficient Education to promote the interests of agriculture is extremely inadequate

Over all philosophy and policy for agriculture have not clearly emerged Suitable provision for training men and women for leadership in the development of such philosophy and policy have not been made in India

In view of these conditions we recommend

1 that agricultural education be recognized as a major national issue

2 that since in a democratic country sound agricultural policy must rest on the understanding and participation of those engaged in agriculture the study of agriculture in primary secondary and higher education be given high priority in national economic planning

3 that so far as is feasible agricultural education agricultural research and the formulation of agricultural policy shall be in the hands of persons and groups or associations of persons who by intimate association participation and experience have first hand penetrating knowledge of agricultural life

4 that so far as is feasible agricultural education be given a rural setting so that it shall include direct participation in and experience with agricultural life and practice

5 that present agricultural colleges be strengthened in equipment and in teaching staff and that each one in addition to programme of well proportioned general and agricultural education endeavour to find some phase of agricultural practice or some related interest such as agricultural credit or agricultural co operatives in which it shall undertake to achieve mastery

6 that new agricultural colleges where possible, be associated with new rural universities so that agricultural education may be supported and enriched by contact with other fields and by common use of personnel and equipment and that each such new agricultural college also explore for some phase of agriculture or related interest often particularly related to its locality in which it will strive to become an outstanding authority

7 that a widespread series of experimetal farms be developed by the central and provincial governments as resources and adequately trained men become available these experiment stations to represent all major types of soil climate crops and topography (The system of experiment stations in the U S A and the Rothamsted Station in England are good types) that as early as possible every basic elementary school every rural secondary school and every rural university should have its own small experimental farm so that the spirit of research and experiment shall pervade all rural life and that where practicable every experiment station or experiment farm be located in association with a school or college where students on work and study programmes may provide labour while becoming acquainted with experimental and research methods

8 that the existing agricultural research laboratories be supported and expanded to the full extent that the quality of their work justifies

9 that new post university research centres be established as university research centres

10 that the Indian Council of Agricultural Research continue to be supported and develop as a clearing house and co ordinating agency for all advanced agricultural research centres as a source of publications and as a source for publicizing the valuable results of research by visual education radio bulletins library loans mirofilm service and by other means

11 that an Institute of Agricultural Policy be established probably under the Council of Agricultural Research for research and study toward the clarification of over all long time agricultural policy for India in accord with the fundamental aims of the Indian constitution and that consideration be given to the feasibility of assembling an international staff of qualified men for that purpose

12 that an agricultural education and research panel attached to the University Grants Commission along the lines proposed in this report for engineering education and research, be established for apportioning available resources for agricultural education and research

13 that the University Grants Commission in association with the Indian Council of Agricultural Research make an inquiry into the merits of public policy involved in the levy of cess taxes on specific commodities, such as cotton,

sugar, jute, lac, and cocoanuts, as a source of research and educational funds, as compared with the policy of block grants from public appropriations, to be apportioned by the University Grants Commission, and

14 that since fisheries, like agriculture, deal with food and fertilizer supply, and since they have been historically associated with agriculture in administration, a careful inquiry be made as to the wisdom of rapidly developed and far ranging research on ocean resources as a possible means for rapidly and greatly adding to the nation's food and fertilizer supply

CHAPTER VII

Commerce

1 that during the period of his study at the university, a Commerce student should be given opportunities for practical work in three or four different kinds of firms

2 that after graduation some of them be advised to specialise in particular profession like Accountancy and received the requisite practical training,

3 that the training for the Master's Degree in Commerce be less bookish and confined to a comparatively small number

CHAPTER VII

Education

(i) that the courses be remodelled and more time given to school practice and more weight given to practice in assessing the students performances,

(ii) that suitable schools be used for practical training,

(iii) that students be encouraged to fall in with the current practice of a school and make the best of it,

(iv) that the bulk of a staff of the Training College be recruited from people who have first experience of school teaching,

(v) that the courses on the theory of Education be flexible and adaptable to local circumstances,

(vi) that students be encouraged to proceed to the Master's Degree only after some years of experience of teaching,

(vii) that original work by Professors and Lecturers be planned on all India basis

CHAPTER VII

Engineering and Technology

General Observation — We have surveyed the engineering and technological institutes of this country giving first degrees or diplomas equivalent to degrees as regards their equipment, staff, intake and output of students, and courses of study We find that in most cases the equipment is insufficient, the staff small and underpaid, and the courses of study too few and stereotyped. The yearly output of engineers is too small in comparison to the demands of the country, growing out of the various schemes of industrialisation and development undertaken by the Government It is 1/40 of that of U S A and 1/13 that of England Post graduate training and research are virtually non existent, and the present system is incapable of producing engineer scientists, or design and development engineers who can plan and execute large scheme With a view to improving the quality and quantity of different classes of engineers and technologists we make the following recommendations

1 that the existing engineering and technological institutes of the country, whatever be their origin or method of administration, should be regarded as national assets and steps to be taken to improve their usefulness according to recommendations of the Advisory Panel of Engineers and Technologists to be set up,

2 the number of engineering schools of different grades be increased particularly for training of grades 4 and 5 (foremen, craftsmen, draftsmen, overseers etc),

3 that engineering schools cover a larger number of fields and branches of engineering to meet the increasingly varied needs of the country If there is unemployment among competent engineers it is because too many are trained in some phases of engineering and too few in others,

4 that engineering courses of study include general education and basic physical and engineering sciences, probably fewer applied courses, and toward the end of the course specialization in some specific field The first year or more of each course should in general be common to all branches of engineering,

5 that as effective engineering education requires works practice along with academic study, this be secured as work during vacations or as postgraduate works training, or as participation in work and study programme during the undergraduate years,

6 that whereever possible, the existing engineering and technological colleges be upgraded for postraguate training and research in selected subjects This requires a class of teachers with different upbringing, habits, and service conditions than the present staffs, hence it may not always be possible to upgrade the present institutes,

7. that steps be taken to start without delay the Higher Technological Institutes as recommended by the Higher Technological Education Committee for training much needed

engineer scientists and design and development engineers

8 that inquiries be made of possibilities for training for graduate engineers and engineer scientists as employed in American industries and other institutions, so that practical know how may be quickly secured for India's industries

9 that in establishing new engineering colleges or institutes there be fresh critical inquiry as to the types of engineering service needed in India Uncritical repetition and imitation of existing institutions here and abroad should be avoided Especially consideration should be given to training which will prepare students to become competent and self relient who will have the initiative and courage to start new industries, even if on a very small scale, to the end that there shall be many sources of initiative and responsibility in India and that a top heavy economic bureaucracy may not be necessary ,

10 that engineering colleges be not controlled or dominated in their administration by ministries or other government departments They should be closely associated with universities, and appointments should be made in the manner indicated elsewhere in this report or if made by the engineering department or college, with the approval and active participation of the university administration where the relationship makes that desirable ,

11 that Faculties of Engineering be called Faculties of Engineering and Technology and should include teachers representing different branches of engineering and technology a few scientists, teachers of humanities and commerce and a number of practising engineers and technologists

12 that the proposed Central Universities Grants Commission be helped by a Standing Advisory Panel for Engineering and Technology, as the fulfilment of the programme of Engineering and Technical Education as visualized by us, will require large grants from the Centre

CHAPTER X

OBJECTIVE EXAMINATIONS

We recommend —

1 That a thorough study of the scientific methods of educational testing and appraisal be undertaken by the Ministry of Education at the universities with a view to applying the results of this study in Indian educational practice ,

2 The Ministry of Education should have one or two experts who are skilled in the preparation and use of objective tests and who understand the underlying procedures and principles, preferably persons who have a Doctor's degree in this field This would provide an agency for centrally organized research of testing procedures and a place where local results in universities might be pooled, and from which advice and assistance could be sought by the universities ,

3 Each university should have a permanent full time Board of Examiners with a small staff of assistants who can do clerical and routine work All the members of the Board which need not exceed three in number, should have at least five years' teaching experience and at least one should be a highly expert person in the field of testing and statistics ,

The two chief functions of the Board of examiners would be

(a) Advising the university or college instructional staff concerning techniques in devising and constructing objective tests for their class examinations and providing criteria and material for the periodic revision of the curriculum ,

(b) Making periodic and thorough inspections by use of progress tests in affiliated colleges which should be required to maintain certain academic standards in addition to the quantitative criteria now required for affiliation

The teaching staff in the different areas of subject matter who are thoroughly familiar with the materials in the lectures and courses would, of course, be responsible for assembling the items to be covered by the tests They would have technical advice of the Board of Examiners in constructing the tests and in interpreting possible results and deviations The Board would reproduce them in the quantities desired, set and give the examinations, score them and announce results

Where would experts for the testing service be found ? There would be at least three sources

(a) Some qualified persons are available at present The Commission encountered some in the course of its visits to the universities More may be available and their services would be utilised in this connection

(b) A group, which would be sufficient to direct Examination Boards at all universities could be developed by intensive preparation and seminars over a period of six months For this purpose we might enlist the services of competent experts in the field from other countries

(c) The Government of India could also provide scholarships for Indians in American Universities and train the requisite number of experts

3 We would recommend that a battery of psychological and achievement tests be developed for use with higher secondary school students for the final test at the end of twelve years of schooling This will, together with other relevant information, serve the purpose of an admission examination to the first degree course at the university The American Council of Education Cooperative Psychological and General Achievement Tests would serve as a model from which to build a satisfactory basis of selection of Indian students That service is adapted for the twelfth grade,

This Commission is now recommending twelve grades as preparatory to college or university work in India

4 We recommend that a set of objective progress tests for guidance and for evaluating class room progress should also be developed immediately

The tests would have to be developed *de novo* for our use They would need to be set up in the language which is used as the medium of instruction and Indians norms developed Norms are established by using the proposed tests on a considerable segment of a typical population of students and discovering the performance of a thousand or more students

These will be scattered over a surface of normal frequency The average or mean performance will become a standard of comparison for calibrating the tests This is the same method that insurance companies use in figuring their tables of mortality The norms for each test in the American Council battery were based upon the records of approximately 6 000 students in twenty five colleges We do not think that it is wise to attempt to establish national norms in India with the diverse conditions of language and other factors, except as a very long range project However, all Indian universities have sufficient student population to set up quickly local or provincial norms This has proved to be the best policy in the United States

No great risk would be encountered in setting up an immediate project in objective tests in this country The tests in the United States which would supply models represent over thirty years of work and scientific experimentation, the expenditure of millions of dollars and wide application in many fields Objective tests are being successfully employed in job analysis and personnel selection in many large business enterprises and were used by the United States Army and Navy in assigning personnel in two World Wars and are now in use in selecting material for officer training as well as admission to the Military Academy and the Naval Academy There are many educational tests besides the ones described here being extensively used The College Entrance Examination Board of the United States which is national agency of high repute administering entrance or matriculation examination now offers testing opportunities for admission to American colleges and universities in 500 centres in different parts of the world

India may derive all the benefits of the costly American experience at little expense and without great difficulty

For purposes of admission to college and university, the tests should be accompanied with much additional information and interviews with students when conditions make this possible It is desirable to get an educational profile of each student by assembling all information pertinent to his record and possibility of success in college The Secondary School Cumulative Record Form in the U S A provides for the recording of the following items . name , religion , sex , date of birth , mental age , chronological age , intelligence quotients , school grades achieved, school grades attended, achievement test and school marks , height and weight, photograph, schools attended, record of attendances and absences, causes of absence, discipline, unusual accomplishments, mental emotional and physical experiences, extracurricular experiences athletic and non athletic clubs and offices, vocational experiences , educational plans educational recommendations, vocational and professional preferences, interests reports, special defects, health mental hygiene, social adjustments and home conditions personality ratings and measurements Information on these items is recorded for each calendar year in such a way that the progress of the pupil can be traced easily across the record form

Recommendations for the Correction of Evils now existing in the Examination System.—Pending the development of objective tests, there are definite steps which could be taken to relieve much that is defective and vicious in the present examinations system

We offer these recommendations some of which have been repeatedly suggested by former Commissions and Committees and most of which were strenuously urged by witnesses appearing before the commission

1 A University degree should not be required for government administrative services Special State examinations for recruitment to the various services should be organised and should be open to whosoever cares to take them That this may not unduly add to the work of the Service Commissions, a small deposit may be prescribed for the privilege of taking the examination, and candidates statisfying a certain minimum standard of achievement may be entitled to a refund This would remove one of the chief evils of the educational system

2 No credit is, at present given for classwork in courses except sometimes in the case of practical work It was strongly urged by a host of witnesses including teachers, students and outsiders that such credit should be given We feel that it will be conductive to efficiency both in teaching and learning It will make it possible to spread the work uniformly during the academic year and the very common practice of working at high pressure in the last few months immediately preceding the examination, which is notoriously responsible for undermining student health and causing severe nervous strain, will be effectively discouraged

We recommend, therefore, that one third of the marks allotted to each subject be reserved for work done during the course of instruction and that this be adopted forthwith in the teaching universities for the B A, and B Sc , M.A and M Sc examinations The affiliating universities should also take immediate steps to evolve a method of more or less uniform marking for this internal award at the affiliated colleges An effective machinery for the supervision and inspection of affiliated colleges to insure uniformity of standards should be devised In postgraduate courses, term papers could be required as a part of this course credit The progress tests which we have recommended above will be of great use in this connection

3 Three years will be involved for the first degree. It is not desirable that all that work should be subjected to one examination at the end of the period That would entail unnecessary mental strain Sections of the course which are more or less self contained can be made the subject of periodical examinations spread over three years' duration A scheme of such self contained units of work should be prepared by each university and the student should be required to pass in all the units befor getting the degree Examination should as far as possible be given in compartments, subject wise and time wise A beginning in this connection can be made with general education courses suggested in the chapter on Courses of Study

4 Examiners should be selected with great care No one should serve as an examinar in a subject which he has not taught for at least five years

Three years should be the limit of continuous service as an external examiner for the first degree exanation After a break of three years, service may be permitted again

5 Every examining authority should have a careful study made of the work done in other countries to discover methods of minimising the outstanding defect of the essay type examination, the subjectivity of marking, and should take all necessary precautions to see that marking is done under closely controlled conditions

6 The standards for success at the examination should, as far as possible, be uniform in the various universities and should be raised We suggest that a candidate should get 70% or more marks to secure a first class 55 to 69% for a second and at least 40% for a third The students will be arranged in alphabetical order in each of the three classes

7 In view of the other recommendations made by us specially one requiring due regard being paid to work during the course, we recommend that the system of awarding grace marks be abolished for the first degree and all higher examinations

8 *Viva Voce* examinations should be employed only for post graduate and professional degrees They should be designed, however, to test the candidates' competence in the fundamentals of the field of study to which the problem of his research belongs

CHAPTER XI

We recommend—

Selection of Students

1 that admission to universities and colleges be based upon merit without discrimination of any kind,

2 that in the first degree stage, the widest possible variety of courses be offered to enable local students, qualified to benefit by an education, to have opportunities which would otherwise be denied,

3 that at the post graduate, professional and advanced research stages, universities should concentrate and coordinate their activities,

Scholarship Examinations

4 that scholarships be awarded by examinations on a basis of merit to gifted but financially needy students,

5 that all students, both men and women, be required to take, at no cost to themselves, a thorough physical examination at admission and periodically threafter, at least once a year,

6 that all universities, with or without Medical Colleges, must have hospitals and dispensaries for student service,

7 that students suffering from infectious, chronic, or epidemic diseases be denied admission unless the university or college has available facilities for isolating and treating those who may have curable diseases,

8 that all staff members and employees of colleges and universities especially food handlers, be examined before employment and the latter periodically thereafter, at least once a year,

9 that health service should include sanitary inspection of campus, buildings, hostels, dining rooms, kitchens and off campus residences, and regular reports submitted to the Vice-Chancellor or other responsible administrative officer,

10 that a nutrious meal be furnished at noon at reasonable cost,

11 that all students be required to be vaccinated against small pox, and inoculated against cholera, typhoid and the plague,

12 that a post graduate degree course leading to a doctorate should be set up at one university in each Province where Directors of Physical Education may be trained,

13 that each university and college remote from a university centre shall have a Director of Physical Education with the status, pay and training comparable to heads of other departments,

14 that provision of gymnasia, playgrounds and equipment are essential to physical education and health,

15 that two years of physical education be required for all students, men and women, except those who are physically unfit or who are in the National Cadet Corps,

16 that physical examinations be followed up with corrective exercises in cases revealed by the examinations,

17 that adequate staff be provided for compulsory physical training and a regular time be assigned for this purpose,

18 that all physical education activities and courses of study be under the Director of Physical Education;

National Cadet Corps

19 that institutions which have not been allotted Units or Sub Units of the Cadet Corps and have not applied, contact immediately the National Cadet Corps Directorate, Ministry of Defence, New Delhi or the Provincial Government,

20 that the Centre should take over from the Provinces and States the responsibility for the administration of the National Cadet Corps

21 that the Centre should detail Regular Officers of the Army, Navy and Air Crops for instruction in the universities and colleges,

22 that the Centre must furnish all equipment including uniforms, defray expenses of training camps and provide a small commutation for each cadet, equivalent to the cost of one meal a day

23 that for housing equipment, armouries or hangars or both are necessary,

24 that there be an annual inspection and rating of all units by Regular Officers not associated with the Units inspected,

25 that there be manoeuvers in the summer in which Army and Air Units work together, that Naval Units take cruises in the summer

26 that enlistment in the Cadet Corps be continued on a two year voluntary basis,

Social Services

27 that Social Service be encouraged and remain on a copletely voluntary basis,

Hostels and Residence

28 that universities establish reasonable standards for hostels, residence and corporate activities as a condition of college affiliation, that these standards be enforced and that no affiliation be granted in the future until standards have been met,

29 that universities supply all hostels with usual furnishings except bedding, towels and linen

30 that all dining rooms in hostels or on the campus be under the direction of a trained dietician,

31 that both vegetarian and non vegetarian diets be furnished, and that no other arrangements be permitted,

32 That all hostels be cosmopolitian in character and the present communal hostels be abolished

33 that students be admitted to hostels on a basis of priority of application, and assigned to hostels in age groups of four year limits,

34 that some staff members should live in hostels and mingle with students as much as is practicable, both as tutors and socially,

35. that advanced students of good character and accepted scholarship be used as Monitors in hostels and in minor roles in dining rooms,

36 that hostels be constructed in blocks of not more than fifty students per block with common rooms and dining halls for four or five blocks,

37 that large hostels be broken up into sections with accommodation for not more than fifty students in each section,

38 that playgrounds and corporate activities be convenient to students living in hostels and also in off campus lodges

39 that all lodges and off campus residential units be rigidly inspected for sanitation social desirability, location and other pertinent considerations,

40 that students be required to reside in approved lodges and living quarters,

University Unions

41 that University Unions should be as free as possible from political activities

42 that Union should be the principal centre of student corporate activities and the federative link of all student organizations,

43 that the Union be operated by students and for students without interference of university authorities,

Discipline

44 that students be encouraged to take interest in good government but not in party politics,

45 that a modified proctorial system in which students will play a large part or student government, be developed,

46 that teachers parents political leaders public and press cooperate in promoting proper life among students,

Student Welfare

47 that an office of Dean of Students be set up in colleges and Universities,

48 that an Advisory Board of Student Welfare be organized in universities which do not have such a body

CHAPTER XII

Recommendations –

1 that the ordinary amenities and decencies of life should be provided for women in colleges originally planned for men, but to which women are being admitted in increasing numbers,

2 that there should be no curtailment in educational opportunities for women, but rather a great increase,

3 that there should be intelligent educational guidance, by qualified men and women, to help women to get a clear view of their real educational interests, to the end that they shall not only to imitate men, but shall desire as good education as women as men get

as men. Women's and men's education should have many elements in common, but should not in general be identical in all respects, as is usually the case to day ,

4 that women students in general should be helped to see their normal places in a normal society, both as women and to prepare for it and college programmes should be so designed that it will be possible for them to do so ,

5 that through educational counsel and by example the prevailing prejudice against study of home economics and home management should be overcome ,

6 that standards of courtesy and social responsibility should be emphasised on the part of men in mixed colleges

7 that where new colleges are established to serve both men and women students, they should be truly co educational institutions, with as much thought and consideration given to the life needs of women as to those of men. Except as such colleges come into existence there are no valid criteria for comparing segregated education with co education ,

8 that women teachers should be paid the same salaries as men teachers for equal work

CHAPTER XIII

We recommend —

1 that University education be placed on the Concurrent list

2 that the concern of the Central Government with the Universities be with regard to finance, co ordination of facilities in special subjects, adoption of national policies ensuring minimum standards of efficient administration and liaison between universities and national research laboratories and scientific surveys etc

3 that for allocating grants to Universities a Central Grants Commission be established, its composition and functions to be as indicated ,

4 that the Grants Commission be helped by panels of experts in different branches ,

5 that there be no University of the purely affiliating type

6 that Government Colleges be gradually transformed into Constituent Colleges of the University ,

7 that private colleges be recognized only on satisfying the University that

(a) they are eligible for gants in aid , and

(b) that they are able to undertake the internal assessment of the students' work ,

8 that College Governing Bodies be properly constituted (and the number of colleges affiliated to a University be limited) ,

9 that the aim of an affiliated college be to develop into a Unitary University and later into a Federative one ,

10 that the authorities of the University be as follows —

(a) The Visitor (The Governor General) ,
(b) the Chancellor (generally the provincial Governor) ,
(c) the Vice Chancellor (a whole time officer appointed according to the methods indicated) ,
(d) the Senate (Court) ,
(e) the Executive Council (Syndicate)
(f) the Academic Council ,
(g) the Faculties
(h) the Boards of Studies ,
(i) the Finance Committee and
(j) the Selection Committees ,

11 that a Grants Allocation Committee be constituted for provinces with Universities of the Teaching and Affiliation type

CHAPTER XIV

Finance

We, recommend —

1 that the State should recognise its responsibility for the financing of higher education

2 that the aid to private colleges should be for buildings and equipment as also for the recurring expenditure the latter be on a uniform basis say half of the present teachers salaries and a third of other approved expenditure

3 that steps be taken to amend Income tax Laws to encourage donations for educational purposes

4 that additional grants be made to colleges and universities in order to enable them to give effect to our recommendations

5 that the Government should contribute an additional annual amount of about ten crores for the development of university education during the next quinquennium.

6 that the University Grants Commission be set up for allocating grants

CHAPTER XV

Banaras, Aligarh and Delhi Universities

We recommend —

1 that the denominational character of the University Court be eliminated and people of all castes and creeds be eligible for membership , and provision for religious education be made along the lines suggested in Chapter VIII ,

2 that the composition of the Court and the other University authorities follow our recommendations in Chapter XIII ,

3 that the All India character of the University be maintained in all Colleges ,

4, that where the College caters mainly to the need of one province its requirements be considered along those of other universities of the Province , 5 that the Intermediate classes be separated and form an independent institution with the two highest classes of the Central Hindu school,

6 that efforts be made to combine the College of Oriental Learning and the Government Sanskrit College in a strong institution,

7 that more generous block grants be provided for the Colleges of Engineering, Technology, Mining and Metallurgy and Agriculture as also for the Science College and the Central Hindu College after a proper scrutiny of all expenditure,

8 that the possibilities of establishing a Medical College be investigated,

9 that the courses be remodelled according to our recommendation in Chapter V and VII and provision made for General Education of all Faculties,

10 that research work be encouraged in all Faculties through the appointment of the best men as teachers through better provision of Library and Laboratory facilities and through the award of generous Fellowships,

11 that the Standing Finance Committee be composed of men with financial experience who may not necessarily be members of the Council and that it be empowered to exercise rigid supervision of the expenditure

CHAPTER XV

Aligarh Muslim University

We recommend —

1 that people of all denominations and creeds be eligible for the membership of the Court and that provision for religious education be made along the lines suggested in Chapter VIII,

2 that the composition of the Court and other University bodies follow our recommendations in Chapter XIII,

3 that the All India character of the University should be maintained in all Faculties especially in the Faculty of Science and in the professional institutions,

4 that the requirements of the Faculties of Arts and Science may have to be considered along with those of other Universities of the province and with those of Delhi University,

5 that the Intermediate classes be separated and form an independent institution with the two highest classes of one of the University schools (the choice to depend on the location of this new institution),

6 that more generous block grants be provided for all the Faculties after a proper scrutiny of all expenditure,

7 that, in particular the establishment of the Medical and Agricultural Colleges and the consolidation of the Engineering College be expedited,

8. that a Library building be constructed as early as possible;

9 that our general recommendations in Chapters IV, V and VII be followed as closely as possible

Delhi University

1 that the relationship between the Colleges and the University should now be definitely settled and colleges which cannot shift to the University campus by July 1951, be regarded as affiliated colleges,

2 that the University be a teaching and affiliating University and conform to the constitution and structure of such a University,

3 that post graduate teaching in Arts, Science, Commerce and Law be concentrated in the University,

4 that for this work the full time University teachers be helped by those who have been appointed by the Constituent Colleges and the University jointly,

5 that as a Central University Delhi should offer facilities for work to students from all over India and in the Faculties with a limited number of seats, students from outside Delhi and its neighbourhood should also have quotas reserved for them

6 that after a careful scrutiny of the present recurring expenditure on teaching activities, a block grant be fixed allowing for the present expense and those likely to occur as part of a scheme accepted by the University Grants Commission,

7 that for research work the University should attempt to co operate with the All India Institute and learned societies at Delhi,

8 that the courses be remodelled on the basis of our recommendations in Chapters V and VII,

9 that the possibilities for further professional education in the University be explored

Additional recommendation on all the three Universities—That the medium of instruction in these universities be the federal language and that during the six years which will elapse before students from other areas can master the federal language instruction be given in both the federal language and in English

CHAPTER XVII

New Universities

We recommend —

1 that during the transition from affiliated or independent college to university status, or during the initial period of a new university a provisional charter be granted by the President, upon the recommendations of the University Grants Commission, and that in general permanent charter be granted only after a provisional period,

2. that Visva-Bharati at Santiniketan, and Jamia Milia at Jamia nagar, near Delhi, be given provisional charters as universities and be given suitable capital and recurring grants,

3. that in the establishing of new universities

freedom be given for pioneering and experiment in educational methods ,

4 that in planning new universities, both urban and rural effort be made to get as good distribution as possible with reference to the total educational needs of the country ,

5 that the University Grants Commission be constituted as the agency for determining the merits of requests for recognition as Universities

CHAPTER XVIII

Rural Universities

CONCLUSIONS

Education in Hope and Courage —Of all the barriers to a great development for rural life almost none is as great as the prevailing vogue of pessimism and futility The greatest and most pernicious myth in all India is the myth of futility and helplessness Our country is throbbing with creative life and power which is ready to burst into action if this myth is exploded

One of the chief duties of all education from the earliest years to post graduation is to dispel the prevailing attitude of futility and hopelessness and to educate our young people in hope and courage The chief limitation of India is what she expects of herself Life in the present world and in India is so complex that no one can make an analysis and plan a sure course The outcome will not depend on external circumstances, but upon the spirit of our people Faith, hope, goodwill and courage are themselves among the most powerful causes of events For education to arouse these qualities in the people will be a greater gift, and greater factor in national destiny, than would the discovery of vast oil fields or sources of atomic power

A Feasible Programme It is apropriate that in the inevitable expansion of higher education in India, a fair proportion of the additional facilities be directed to meeting the needs and developing the opportunities of rural areas The conditions necessary for initiating the programme are present There are among Indian educators and among educated constructive village workers today enough qualified men and women to staff one or two or three such universities with persons who have the necessary preparaton outlook and spirit Boys and girls who have been through basic education schools are approaching the age when they will be ready to continue basic education methods at a higher level By the time the new institutions are ready, a qualified, suitable student body will be pressing for entrance

We recommend that special attention be paid to the development of higher education in rural areas along the lines indicated

---

TRAINING IN CHEMICAL ENGINEERING AT THE M.I.T.

BAZLE KARIM AND TUHIN K ROY

DEPARTMENT OF CHEMICAL ENGINEERING MASSACHUSETTS INSTITUTE OF TECHNOLOGY U S A

IN keeping with the growing interest in the newly developed subject of chemical engineering and the introduction of chemical engineering courses in an increasing number of educational institutions in India in recent years it is necessary that proper considerations should be given to the problem of providing adequate practical training in the subject, facilities for which are practically non existent at the present moment Considerable difficulties had been experienced in the past by the leading educational institutions of the United States where the subject of Chemical Engineering as it is known today was chiefly developed, in the setting up and operation of a suitable Chemical Engineering Unit Operations and Unit Processes Laboratory These difficulties arise mainly for two reasons Firstly the field being still young, new equipment is constantly being designed and developed, and even now Unit Operations are in the process of being evolved, as a result of which equipment becomes obsolete within a short time and the financial outlay for equipment that quickly becomes obsolete is beyond the means of ordinary educational institutions Secondly, the cost of raw materials necessary to operate this equipment is often prohibitive and this presents a new problem not previously met with in the operation of large scale electrical and mechanical engineering laboratories

Furthermore the most effective lessons in Chemical Engineering Unit Operations and Processes can be learnt only from the operation of standard equipment when it works in cycle with other equipment which is out of the question in any educational laboratory

As in the theoretical development and organisation of what is now known as the subject of chemical engineering so also in the development of an effective system of practical training the Department of Chemical Engineering of M I T pioneered to overcome these difficulties The resulting system which is the outcome of the efforts of outstanding teachers in the subject might be studied with advantage for adoption in the proposed first grade technical institutions that are to be established in India in the near future

At the suggestion of the late Dr Arthur D Little, one of the founders of modern chemical engineering, a co operative course in chemical engineering in which the Massachusetts Institute of Technology would unite with progressive chemical industries in the training of student engineers was started under the direction of Dr William H Walker in 1917 The chemical industries agreeing to co operate with this scheme were to permit the use of their plants as a laboratory and the faculty of the Department of Chemical Engineering of M I T was to supply the instructional staff This plan incorporated in the School of Chemical Engineering practice of M I T has been in operation for 32 years with minor breaks during the two intervening world wars and is a unique experiment which has proved so successful that to quote Prof Whitman Head of th Department of Chemical Engineering at M I T it is now a keystone in the program of graduate instruction which attracts men from all over the world

Started with funds from Mr Eastman for a five year trial its future was early assured by the hearty co operation of the industries and of the students

The M I T School of Chemical Engineering Practice at present consists of training in three field Stations under the direction of a General Director at M I T and a resident Director and an Assistant Director at each station who are maintained by the Institute and are entirely responsible for the students work and for relations with the plant Three different groups of about ten men each start at the same time one at each station and each group shifts to the next station after two months By this system of rotation the work of the entire school is completed in six months

The three Field Stations are located at Bangor Maine Parlin New Jersey and Buffalo New York The companies co operating with these Stations are

Bangor Station	The Eastern Corporation and The Penobscot Chemical Fibre Company
Parlin Station	The Hercules Powder Company
Buffalo Station	The Bethlehem Steel Company

These industries include the manufacture of sulpite and soda pulp writing paper electrolytic caustic soda and chlorine heavy acids and chemicals nitrocellulose plastics and explosives cellulose acetate plastics and chlorinated rubber the purification of various organic solvents and chemicals by the various diffusional processes iron and steel gas and coke (including the byproduct recovery of benzene toluene xylene etc) and various types of structural pieces

OBJECTIVE OF THE PRACTICE SCHOOL

The fundamental objective of the Practice School in general terms is to help develop in the student engineer the qualities of leadership personality initiative co operation common sense judgement industry and intellectual resourcefulness The theory of the system is based on the fundamental fact that any modern engineering undertaking is a co operative and collective affair where the actual values of an individual is quite often determined by his ability to play an effective part in a group his resourcefulness in tackling problems and above all his ability to apply theory to practice Prof Walter G Whitman has summarized this in the following words —

> The whole course in chemical engineering is based on a philosophy that a trained capacity to attack problems out weighs the value of specialized knowledge The Practice School stresses planning and the habit of getting things done rather than the accumulation of factual information about the particular industries where the stations are located
> the school should develop a scientific attitude and method of attack The critical and inquisitive point of view is particularly healthy in a profession which concerns itself with pioneering enterprises

The type of work done in the Practice School can best be described in the following paragraph taken from M I T catalogue

> The quantitative aspects of chemical engineering are intensively studied In addition to tests on industrial equipment plant investigations are carried out by the students on some special phase of one of the unit operations on some problem of industrial chemistry which is particularly important at the station in question

METHOD OF TEACHING

Considerable attention has been given by the designers of the course to develop the method of teaching It was realized at the very beginning that work on labour shifts does not have much technical educational value The best method was decided to be the assignment of actual problems that exist in the plant for solution to the students The problems are given to the student in the form of a memorandum which usually runs as follows The Blank Chemical Company is experiencing such and such difficulty in the operation of such and such equipment You as the Company s engineering group are asked to investigate the trouble and recommend remedies Please submit your results in the form of a technical report before such and such a time on such a date Depending on the nature and magnitude of the problem two to ten students are given one or two weeks to investigate and report on the problem The formulation of the plan of attack the design and construction of the equipment necessary to carry out the necessary tests the development of methods of quantitative analysis of difficult mixtures etc, are left entirely to the students although guidance is freely available from the instructors whenever necessary But it is the student who takes the major decisions regarding the data needed how they should be obtained, the methods to be used to calculate the results and what results are needed to form a sound engineering judgment on which to make a recommendation that will improve the operation of the plant

Tests are carried on both on the Unit Operations and the Unit Processes of Chemical Engineering Thus the groups in which the authors took their training were asked among many other problems to evaluate the performance of a Carbate heat exchanger in a paper mill, the efficiency of a phenol stripping tower in a coke-oven by product recovery unit in a steel plant, the performance of a lime tower for chlorine disposal which are all problems in Unit Operations Also, there were problems like the evaluation of the performance of a Cottrell Precipitator in a paper mill for the recovery of sodium salts the determination of carbon tetrachloride losses during chlorination of rubber in a plastics factory the performance of a nitrator and the determination of pulp losses from the shaking screens in a paper mill These are problems in Unit Processes Then there were problems like the design construction and operation of a test column for the neutralization of chlorine water by passing through an up flow limestone bed the design and construction of an ultrasensitive micromanometer the determination of material and heat balances around an open hearth furnace the survey of flue temperatures in coke oven batteries the investigation of cambers in structural steel bars the development of a method of evaluating power and process steam costs in a paper mill – problems that might be called problems in general engineering

These problems are handled on a cooperative and collective basis by the groups to whom they are assigned and usually require an intense degree of well coordinated efforts on the part of the entire group to meet the dead line fixed for the submission of the report Usually a leader is chosen for a long plant investigation problem who is directly responsible to the Director for the coordination of the group effort One man is assigned the position of log man and he collects and tabulates data which are being obtained by the other members of the group It is the duty of the leader to check the reasonableness and accuracy of the data as they are being collected The leadership changes with every new problem As many of the tests last for more than sixteen or seventeen hours at a stretch the leader of the group divides the group into shifts if necessary although sometimes the whole group might be required to work for a very long stretch of time continually which is real test of physical and mental endurance that an engineer should be able to stand occasionally

A Typical Example

As an example of the type of work done in the Practice School the following problem assigned to the group of which one of the authors was a member during training at the Bethlehem Steel Corporation is described in some detail

Problem Heat and material balances around an open hearth furnace

Time Two weeks

Organization of Preparatory Work

1 Construction of a high velocity thermocouple for the measurement of stack gas temperatures

2 Construction and calibration of suitable thermocouples to calculate radiation losses from outside surface of the furnace

3 Determination with a bomb calorimeter of the heating value of pitch used in the firing of the furnace

4 Determination of carbon hydrogen ratio in the pitch

5 Analysis of the slag for Ca, Fe P etc

6 Analysis of scrap and ingots for Ca Fe P etc

7 Tracing of the exact routes of inlet and outlet of matter and heat

8 Weighing of the charge as well as of the product steel and slag

9 Setting up and operation of an Orsat Apparatus for the analyses of stack gases and coke oven gases

10 Determination of temperatures inside the furnace and of outgoing material with optical pyrometers

11 Development of methods of calculation

After some degree of proficiency was obtained in the carrying out of the above mentioned operations the actual test was carried out over a period of 12 hours each day for two days

An eighty page typed report was submitted giving a detailed account of the findings and at a later date the results were orally presented before a joint meeting of the M I T group and the plant engineers for discussion

Distribution of Work at each Station

The work is distributed over a period of 8 weeks at each station in a definite way The first week or two are devoted to detailed and very thorough plant acquaintance drawing up detailed block and line flow sheets involving every piece of important equipment in the whole plant along with operating data an inked elevation drawing of a particular section of the plant and the preparation of questions on various details of the plant and on the measurement of fluid flow temperature and pressure The next week is devoted to the tackling of short problems in groups of two or three men The 3rd 4th 5th 6th and 7th weeks are devoted to long problems and the last week is devoted to cleaning up the laboratory taking of inventory correction of reports and final conference

Chemical Engineering Plant Design

On return from the Field Stations all three groups work intensively for 1 month on the integrated design of a new plant from the viewpoint of both chemical engineering and economics The system of organization and distribution of work is on the same system as in the Field Stations The complete design might run up to several hundred pages of typewritten matter along with several blueprints and diagrams A Polystyrene Plant for the production of 12 500 tons of product per year and a liquid sulphur dioxide plant producing 12 tons a day were designed by the last two groups of which the authors were participating members

Stress on the Art of Self Expression

Utmost thought has been given to evolve a plan to teach the art of self expression to the students This is done through the writing of the numerous technical reports and memoranda as well as through oral *presentation of reports* *Each student has to* give a 20 minute talk on some technical subject at each station The merits and defects of the speech are commmented upon by his colleagues in printed forms listing the various aspects of a speech like introduction clarity precision interest friendliness control of body etc

DIFFERENCE WITH INDIAN SYSTEM

The main difference between this system and the system in India is that the training in M I T is guided by members of the faculty and the training consists of extensive experimental work on a plant scale Besides the training constitutes half the requirements for the degree of Master of Science in Chemical Engineering Practice and this automatically involves the evaluation of the performance of the student in relation to the group This is done by the staff on the basis of the qualities of leadership personality intellectual ability cooperation industry common sense and judgement and initiative which are beyond doubt the qualities that an engineer must have to fulfill his professional responsibilities

ADVANTAGES OF THIS TRAINING TO BOTH THE PLANT AND THE INSTITUTE

This system of training engineering personnel is advantageous both to the students and to the plant in that the students get the necessary professional confidence before they get into a job while the plant gets a lot of free information regarding the operation of its various units A number of recommendations based on the investigations of the M I T Practice School Groups regarding the possible methods of improved operations of certain units the installation of new equipment for the recovery of various waste products and the possible ways of repairing faulty equipment have been acted upon in each of the factories where the present stations are located The expenses of operating the Practice School are borne entirely by M I T while the plants provide the necessary housing and allied facilities The contract the students sign with the company undertaking not to divulge any secrets of the companies concerned gives the necessary protection to the secret processes of the plants

With a reasonable degree of co operation on the part of our industrialists in India there is no reason why this system which has been operated with such tremendous success at M I T should not work successfully in India too The adoption of such a scheme should be all the more welcome to the industries in India in view of the fact that most of our industries are usually understaffed in engineering personnel and the availability of the help of a group of intelligent young engineers would help the operation of any of our existing chemical industries in India Now that our country is free and we look forward to a great era of intensive industrialisation before us it will not be too much to hope that enlightened and patriotic industrialists of India will gladly stretch out their hand of co operation if this scheme of training student personnel is given its due share of consideration for future adoption in the proposed regional Institutes of Technology and in the existing departments of Chemical Engineering or Applied Chemistry in the Indian universities and colleges

BIBLIOGRAPHY

Whitman W G *Industry* p 40 Oct 1938
Haslam R T *Ind Eng Chem* 13 465 1921

SYNTHETIC FOOD PRODUCTION

M N KRISHNAMURTI
CHEMICAL ENGINEER BOMBAY

FOOD assumes an important place in national planning It is not enough to supply sufficient food to meet merely the caloric and energy demands of the nation but it must be of such nutritive qualities that will also permit adequate amounts of the dietary factors now known to be essential for health and well being All kinds of flour products such as from cereals potatoes and oil cake essentially contains protein and carbohydrate The protein builds and maintains the body tissue while the carbohydrates furnish body heat and energy To an extent upto 3 per cent fat is also present in cereals and potatoes and this furnish body heat and energy and carry fat soluble vitamins and supply essential unsaturated fatty acid In the expeller pressed oil cakes the fat is present some times as high as 8% This high percentage of fat cannot easily be digested Furthermore the meal with high fat content will become rancid when stored and the meal will turn out to be an inferior kind of food If this cake is solvent extracted the defatted meal will be left with less than 2 per cent oil content and such a meal will readily be accepted as a food product

All over Europe and America the synthetic food or macaroni form a very versatile portion of the countries diet and are generally used in making a sweet or dessert but in this country it is not so much popular In those countries where wheat is grown in plenty semolina obtained from wheat of high albumin content is always employed by the macaroni manufacturers as with the use of such a flour best quality of macaroni could be manufactured Turning to the acute shortage of cereals in our country and the general trend in developing other subsidiary food to meet this shortage, flour obtained from sweet potatoes, tapioca and groundnut oil cake can satisfactorily be employed in the process instead These flours as examined before shall be able to comply with the exact physical properties as required for the trade by improved methods of flour milling and by suitable blending of the different kinds of flours The macaroni manufactured from these flours if popularized, besides being quite inexpensive and within reach of the common man will also approximate the cereals in its caloric and nutritive value It is therefore in the interest of the numerous financial concerns which have dropped the prospect of manufacture of macaroni on account of the difficulties of procuring a continuous supply of the wheat that they should reconsider their position with reference to these raw materials Later on when the grain situation improves, they can switch on their plant to the normal raw materials without sustaining any financial loss

One important consideration for the manufacture of macaroni is the requirement of a high grade light coloured flour as demanded by the trade In order to obtain flour of good quality from sweet potatoes and tapioca, these should be first washed in a suitable machine free from foreign material It is next ground in a hammer mill to a form suitable for drying After drying to a required moisture content it is again ground in another hammer mill and screened fit for use

Obviously the outer skin if peeled off and ground in the hammer mill will definitely furnish a product of good light colour but this will significantly increase the cost of the flour It is therefore economical to grind the products in its original state and subsequently bleach the flour by means of sulphur dioxide while still wet from the hammer mill It is estimated that 100 tons of raw potatoes will yield approximately 22 tons of good flour containing 9% moisture, assuming 5% loss in the process The milling of groundnut oil cake is different from the one described above Here the carefully picked up groundnut seeds after removing the red skin is pressed twice in the expellers, if the ordinary expeller oil cakes are used for conversion into flour By this the oil content in the cake will be reduced to the very minimum It is next pulverized in the same hammer mill or cake crushers, and the flour screened and supplied to the users

PROCESS OF WORK

The various flour ingredients blended in suitable proportions confirming to the physical characteristics required for the macaroni manufacture is mixed in the form of a paste with 25 30 per cent of warm water at a temperature of 70° 140°F Occassionally a small amount of salt is added during the process The mixed ingredients thereafter pass directly from the mixer into the kneader where it is kneaded into a homogeneous dough The dough is then forced through a die in a paste goods press The press is usually maintained at a temperature of 104°F to keep the dough plastic while the macaroni is extruded through the dies An operator who attends to the press cuts the strands into suitable lengths with a sharp knife and places them on drying rods mounted on trucks When so drying he skillfully separates and spreads each individual strand to prevent sticking and to facilitate subsequent dryings The trucks are then wheeled into drying rooms, where the macaroni is subjected to the drying process until it is thoroughly cured The most difficult part in the manufacture of macaroni is the process of drying The process of drying is a matter of controversy among many of the experts while it is genrally believed that these products cannot be cured in less than 48 hrs time in the drying rooms, the time taken varying considerably according to the type of the drier in use and the number of operations which go to make up the curing process In one of the best known systems of drying the macaroni, termed sweating and drying process the moisture from the inside portion of the goods is brought to the surface from which position it is safely evaporated This sweating and drying process is carried out alternatively in several stages until the goods thoroughly cured If such a system is not adopted, the outside of the product will dry too rapidly, and a case hardening effect will be produced which will rapidly result in cracks forming on the surface owing to the still plastic condition of the interior of the product, besides in a few days time at the most mildew will form

EQUIPMENTS REQUIRED

Plants are manufactured for batch and continuous operations For the last decade or so the continuous process has far overshadowed the batch type unit and most of the macaroni manufacturers in the continent and America now employ continuous type of paste goods presses only In the continuous process the ingredients are fed automatically and the process of blending, mixing, kneading and extruding all done by one self contained unit There is also an automatic spreader attached to the continuous machine which places the strands of extruded macaroni on drying sticks trimming them at the same time to the required length This automatic macaroni press has been further extended by the development of the automatic continuous dryer This dryer unit is provided with the necessary thermostatic controls of temperature and humidity of the air obtaining a perfect physical condition in the macaroni The entire working takes place in completely enclosed machine units under strictest hygenic requirements eliminating any possibility of touching the goods by the operators and to the extent of even filtering the air used in the drying rooms thus excluding all forms of contamination. Besides the whole process being automatic once it is set, continuously turns out the first class goods with a minimum of attention and skill from the man-in charge.

POSSIBLE ECONOMY

For an investment of 3 lacs of rupees on machineries 4 tons of macaroni per day can be produced at a cost of Rs 60 per ton i e half an anna per lb This figure includes all costs such as for electric power labour and supervision depreciation on process equipments except that of materials sales expense and packing cost for the product In computing costs the following assumptions are made The plant would operate 300 days in the year The press would operate for 8 hours per day while the drying chambers will work for 24 hours per day This estimate is based on the practice of an established pasto goods manufacturing business and therefore if well planned can provide our country with good nutritional diet

REFERENCES

1 Making potato flour meal and feed at low cost *Food Industries* July 1949 (Vol Page 918) p 80

2 Continuous presses stop up production of Macaroni by J J Winston Chief Chemist and B R Jacobs Director Jacobs Cereal Products Laboratories Inc N Y (*Food Industries* March 1948 p 74 (Vol page 344)

3 Britain s Macaroni Industry By Eri Quiney Food Manufacture April 1947

4 Efficient uses of Food resources in the United States By Raymond P Christensen Technical Bulletin No 963 October 1948

CONTROL OF RUST EPIDEMICS OF WHEAT IN INDIA—A NATIONAL EMERGENCY *

MY original intention was to discuss from the physiological view point the present state of our knowledge of wheat rust but your Director expressed a wish that I should give a popular talk on the rust problem of India and the methods that may be employed for the control of rust epidemics a subject of special interest in these days of acute shortage of food grains

Wheat more wheat and yet better wheat produced within the country is a great National need in so far as the price of almost every commodity of daily use in the greater part of the country is translated into the weight of wheat sold for a rupee With a higher yield of wheat more of rice should be available for this province as well as the southern parts of the country

I THE WHEAT RUST PROBLEM

4 *General* —Rusts of wheat are caused by three different species of a parasitic fungus called *Puccinia* In common English they are known as yellow brown and black rusts respectively because of slight differences in their colour with the naked eye it is not easy to distinguish between the last two Yellow and black rusts also attack barley The Indian names for rust are *Rati Ratua gherui* and *tambera*

Each of these rusts spreads from plant to plant by microscopic germs (uredospores) that are blown by wind In favourable weather a single germ may give rise within a week from the time it alights on a wheat plant, to several blisters (uredosori) each containing several hundred fresh germs That explains how from a few rusted plants a serious epidemic might be caused in the short space of 4 6 weeks if weather conditions happen to be favourable for the spread of rust

Towards the end of the period of growth of the host plant the parasite produces thick walled resting germs (teleutospores) to tide over the impending unfavourable period winter in temperate climates and summer in the tropical regions

B Life histories —The life history of black rust in countries or parts thereof with a severe winter is completed on another plant called barberry (*Berberis*) which is not in the least related to wheat and the germs produced on this alternate host cause the initial infection of rust on wheat in the following spring

Similarly a wild plant called *Thalictrum* was successfully infected some 30 years ago in U S A as a result of artificial inoculations with germinating resting spores of brown rust but so far no alternate host has been discovered for yellow rust

In the year 1897 Eriksson a Scandinavian mycologist and a pioneer worker on Cereal Rusts made a startling statement that fresh outbreaks of rust are caused by an internal inherited and invisible germ inside the seed grain which he thought might take from 2 weeks to 9 months from the time of sowing of the seed to assume a visible form He also asserted that the length of the incubation period (the time which rust takes from the moment of its entry into the host to produce fresh blisters) is fixed at 10 days This led to a lively controversy but on the whole gave a set back for nearly two decades to further investigations on the factors responsible for annual recurrence of rusts

---

*Full text of the Eleventh Acharya Jagadish Chandra Bose Memorial Lecture delivered by Dr K C Mehta Principal and Professor of Botany, Agra College, Agra, on the occasion of the thirty second anniversary of the foundation of the Bose Institute, Calcutta on November 30 1949

There is incontestable evidence to show that the length of the incubation period is not only not fixed but varies considerably according to light and temperature particularly the latter and may be prolonged for several weeks in very cold weather Also that there is no hereditary germ of rust inside the seed grain

The factors of outstanding importance in relation to annual recurrence of black rust, the most destructive of the three are —

(i) Presence of rust on berberries in spring in cold countries or parts thereof where as a result of severe winter the uredospores (summer stage) and the vegetative part (mycelium) of the parasite inside the host are killed and

(ii) Overwintering uredospores on and mycelium inside the self sown (volunteers) wheat and barley plants green stubble and ratoon tillers from harvested plants in regions with a mild winter Perennial grasses are also known to carry over rust from season to season in some of the countries

Brown rust of wheat and the yellow rust of wheat and barley are propagated from season to season in the uredostage with the exception of those countries or parts thereof where weather conditions make such survival impossible They are re introduced to such regions by wind from localities of earlier outbreak

C *Physiological aspects* —It has long been known that as a result of more or less rigid restriction of parasitism there are several specialized forms or biologic races of black rust and amongst the cereals the biologic form of wheat is restricted to wheat and barley and infects only weakly some varieties of Rye (*Secale cereale*) it does not infect oats at all

The brown rust of wheat is restricted to wheat and the yellow rust to wheat and barley

In addition some of the wild grasses have been found to act as collateral hosts infected simultaneously of black and yellow rusts of wheat

With regard to the role of wild grasses in the annual recurrence of a rust it is important to note that only perennial grasses on which rust can survive during the critical period particularly when there is no cereal crop available can 'carry over the infection No such grass has yet been found in India as far as the rusts of wheat are concerned

The task of tackling the rust problem by the breeding of rust resistant varieties is very much complicated owing to the occurrence in nature of many physiologic races under each of the three rusts *i e*, the black brown and yellow This important discovery was made nearly 30 years ago in U S A and since then intensive work has been done on the study and isolation of these races in almost every country where wheat is extensively grown The identification of physiologic races, a highly technical and specialized study, is done with the help of seedlings of different species and varieties of the genus to which wheat belongs, standardized by Stakman and his coworkers to whom goes the credit as pioneer workers in this field Each race produces different types of reaction on the differential hosts, heavily infecting some whereas on others the infection may be moderate or weak and still others are not at all infected (immune) On these lines nearly 200 physiologic races of black rust of wheat alone have been reported from different parts of the world and the International list of all the three rusts taken together deals with nearly 350 races A large number of the races of black rust has arisen as a result of hybridization (crossing) between different races on berberries in the U S A This explains how difficult it is to produce a variety or varieties of wheat which would resist many if not all the races All the same some promising varieties have been bred which resist most or at least many of the predominant races

From an intensive study of cultures of all the three rusts of wheat grown simultaneously by me at Cambridge during 1920 1922, with the object of finding out the influence of temperature on the viability of uredospores as well as of low temperatures on the growth of the mycelium and the duration of the incubation period some interesting data were obtained This study was followed by similar investigations at Agra in 1927 and 1928 on the effect of comparatively high temperatures on the viability of uredospores The data are worthy of note in so far as they have a direct bearing on the weather conditions in Nature under which any of the rusts may or may not survive

(i) Uredospores of black rust retained better viability at comparatively high temperatures than those of yellow which suffered most from heat and kept more viable at lower temperatures The uredospores of brown rust however combined the powers to resist cold as well as heat

(ii) After exposure to 6 5 to 10°C in cold storage for a week uredospores of black rust showed almost a total loss of viability whereas those of the other two were still viable (germination between 25 and 10%)

(iii) After 3 hours exposure fresh uredospores of black rust showed a decline from 50% viability at 32°C to 10% at 47°C those of brown suffered a drop of 20% but in the case of yellow the viability fell down from 40% at 30°C to less than 2% at 47°C

When kept in a room in the laboratory uredospores of yellow rust showed a much greater decline in viability than those of the other two within the same period

Whereas complete loss of viability of uredospores took place after 18 hours' exposure at 47°C in the case of black rust and at 45°C to 47°C brown spores of yellow rust were killed even at 42°C after the same period of exposure

Uredospores of all the three rusts retained a fair amount of viability even after a month at 5°C

(iv) At a range of average daily temperatures of 38 6 to 50 6°F (average of 40°F for the whole period) pustules (blisters) of black, brown and yellow rusts appeared after 21, 17 and 12 days respectively

At 43 5 to 58 0°F (average for the whole period 50 8°F) the pustules took 14 13 and 11 days respectively to appear

At 48 5 to 58 8°F (average for the whole period 54 1°C) the rust appeared after 11 8 and 8 days respectively

At 59 1 to 71 8°F (average for the whole period 66 5 F) the rust appeared after 8 8 and 12 days respectively)

At Cambridge plants inoculated with yellow rust in February 1921 and kept in the open developed rust after 35 days the control inoculated simultaneously and kept in a greenhouse at 60 70°F showed rust after 12 days

In the Rust Research laboratory at Simla the range of the incubation period in the open during December to February the three coldest months of the years has been found to be 15 26 days 12 20 and 10 16 days in the case of black brown and yellow rusts respectively

These data clearly show that the duration of the incubation period is largely determined by temperature which has a marked influence on the rate of growth of all plants

Further that under low temperatures black rust takes the longest time to appear and yellow the shortest At higher temperatures the position is reversed

In fact the mycelium of each rust grows by fits and starts under unfavourable conditions of weather and if such conditions get worse and persist for a considerable period it may even be killed That explains the disappearance of rust from certain areas year after year and its continued absence till re introduction from other localities or from an alternate host if one happens to function locally as a result of the viability of the resting germs (teleutospores)

II RESULTS OF PRACTICAL VALUE TO INDIA

(i) *Berberis vulgaris* Linn and *Thalictrum flavum* the two most susceptible species of alternate hosts of black and brown rusts respectively do not occur in India Whereas several other species of these hosts grow wild in the hills of India there is no case on record nor could any evidence be obtained during recent studies of an outbreak of either of these rusts starting from its alternate host As stated above no alternate host has so far been discovered anywhere for yellow rust

Viable resting spores (teleutospores) of none of the three rusts are found in the plains and the same applies to moderately high altitudes (nearly 6 to 7 thousand ft a s l) produced as they are in comparatively warm weather and are later exposed to still higher temperatures Successful germination of these spores was obtained in the laboratory at Simla in 1933, in this country for the first time, with material produced in autumn by artificial inoculations made in July the same year; this was done to simulate conditions in temperate climates where these spores are produced to tide over the intensely cold winter For a period of nearly 10 years intensive study was made of the susceptibility of several species of *Berberis* and *Thalictrum* indigenous as well as exotic Three indigenous species of the former and two of the latter have been found to be moderately susceptible but for want of viable teleutospores at the altitudes where these species grow their infection in nature is very unlikely several bushes of one of the susceptible species of *Berberis* are growing in the compound of the laboratory at Simla but in the last 19 years no one of them has been found to be infected with the black rust of wheat

(ii) Both black and brown rusts have repeatedly been found to break out in the plains of Peninsular India as *early* as September on the summer crop of wheat and during November December on the winter crop In general wheat is harvested in the plains well before the earliest possible infection of *Berberis* and *Thalictrum* in the hills and the rust found so far on these hosts is not connected with wheat

These alternate hosts therefore play little part in the annual recurrence of black and brown rusts at any rate as far as the plains are concerned This is borne out by an indirect proof but a strong proof all the same that even after 17 years study of physiologic races which increase by hybridization on the alternate hosts only 10 of black and 9 of brown have been found from rust collections made in the hills as well as the plains

(iii) Owing to the intense heat of summer that follows the harvest in the plains of India in general the uredospores (winter stage) of all the three rusts are killed and there is no host for them to live on Consequently there is no local source of infection for the following crop year after year in more than 95% of the acreage under wheat and barley in this country

This fact offers a unique opportunity for the control of rusts in India

(iv) In the Indo Gangetic plain which covers the greater part of the area under wheat and barley normally yellow rust does not appear before January and the brown and black break out as late as February March notwithstanding the fact that from the middle of October onwards the weather is thoroughly congenial for the growth of rust In some of the districts of the United Provinces bordering the foot-hills of Nepal however, rusts have been found to appear towards the end of December this is due to early sowings (August-September) in Central Nepal where well advanced infection has been observed earlier

Owing to the unfortunate and highly injurious practice of growing wheat during summer in vogue in the hills hilly tracts and plains of some parts of Bombay, Mysore and Madras black and occasionally also brown rust appear as early as August September in the hills and September October (on late sown summer wheat) elsewhere It is evident that the summer crop 'carries over' rust to the *rabi* (winter crop) sown during October (*v*) In contrast with the plains where, as stated above the germs of rust are killed by the intense heat of summer all the three rusts are able to oversummer in the hills at altitudes suitable to each after the harvest on green stubble, ratoon tillers from harvested plants and self sown (volunteers) plants which sprout from the grain that falls to the ground during harvesting These 'out of season plants carry over' rust from one season to the other in the uredostage and cause infection of the normal crop (*rabi*) sown early in winter in the hills

It is unnecessary for any of these rusts to pass on to the alternate hosts as would be clear from the fact that they have successfully been maintained in uredo cultures for a period of over 18 years, throughout on the living plants of wheat in a glasshouse attached to the laboratory at Simla the oldest of these cultures had completed its 268th generation by the end of June 1949 The temperature of the glasshouse is controlled, by cooling devices, in the day time so as not to exceed 80°F which is approximately the maximum shade temperature during the greater part of winter in the northern plain

(*vi*) On several occasions fresh outbreaks of rust have been observed in the hills during November hardly 4 6 weeks after the sowing of the new crop, within a few feet of stray plants of wheat heavily infected with the same rust There is plenty of inoculum (infective material) on out of season' plants and ratoon tillers from harvested plants in the hills, at altitudes suitable to each rust, at the time of sowing of the normal crop (*rabi*) during October November

Well advanced infection of early and normal crops in some of the hills has also been observed before rust outbreaks in the neighbouring plains

Wheat sown out of season at some of the foot hill stations in the south, at my request, got infected as early as September October *i e*, 2 4 weeks before the normal period of sowing of *rabi* in the neighbouring plains

(*vii*) In general, each rust has been found to appear much earlier and plant for plant there is heavier infection at the foot hill stations than at places farther off in the plains

(*viii*) This does not mean that at any locality in the plains every field much less each plant, should get infection direct from the hills In fact, this is extremely unlikely and not at all necessary because after the infection of a few odd plants, with germs directly from the hills or from a locality of earlier outbreak in the plains, in any field rust should spread much faster in the plains due to milder weather and consequently after shorter incubation than in the hills Later on infection may spread from one locality in the plains to another as a result of dissemination of the germs by convection currents and upper air winds

(*ix*) The foci of each of the three rusts lie in the hills where they are propagated from season to season as uredospores on the normal crop, 'out of season' plants or the summer crop wherever grown Following the outbreak of rust on the hill crop the uredospores are blown by wind to the plains

This conclusion is based on an intensive study of rust dissemination carried out for a period of six seasons (1932 33 to 1937 38) with the help of stationary slides exposed at a large number of representative stations of undivided India, slides exposed on kites and large size hydrogen balloons at Agra and from an aeroplane at Delhi In addition, wind trajectories were prepared for several stations in different parts of the country mostly for winds at 1640 to 6560 ft a s l In all over twenty thousand slides were examined for spore showers and the number of wind trajectories studied and scrutinized for their significance in relation to rust appearance came to 11,355

(*x*) Uredospores of each rust were caught several times on stationary slides exposed in aeroscopes at a large number of stations 4 2 weeks before the date of its initial outbreak on the local crop The same was found to be true of slides exposed at Agra on kites and hydrogen balloons

Uredospores of all the three rusts were caught on slides exposed from an aeroplane at Delhi at different heights up to 10,700 ft a s l and some of them were found to be viable

The striking similarity between the physiologic race flora of the hills and the plains, as demonstrated by the analyses of rust collections, is another proof of the location of foci of infection in the former

The foci in the north and the south seem to be circumscribed as revealed by the study of wind trajectories

(*xi*) In so far as the hills occupy less than 5 per cent of the total acreage under wheat and barley in this country and as there is no source of rust locally in the plains at the time of normal sowings, except on the summer crop in some parts of Peninsular India, the opportunity of tackling the problem is rare

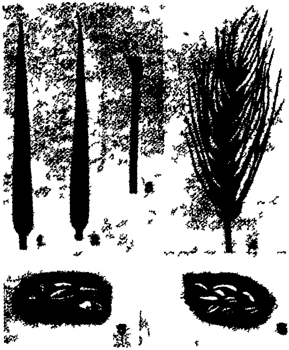
III Damage Caused by Rusts

A Outside India —Arthur and his collaborators in their book entitled 'Plant Rusts', published 20 years ago, have quoted colossal figures of loss amounting to 10 million dollars in Australia, 12 millions in Saxony, 100 millions in Western Canada and 115 millions in the Upper Mississipi valley from black rust alone during 1916 the greatest 'rust year' According to another estimate the average annual loss to the world from rusts of cereals comes to 300 million dollars

During the 10 year period, 1915 24 the average annual loss in 13 States of the Upper Mississipi valley from black rust alone amounted to over 55 million dollars

These authors have stated that the value of these figures is to give some comprehension of the enormous economic importance to be attached to the rusts, and to justify from the purely commercial side the expenditure of time and money in their study.

Cereal rusts are undoubtedly the most important and also the most serious of all the plant diseases of field crops Not only is the total yield of grain reduced by rust but the kernels (seed) formed are often shrunken and of inferior quality It has often been stated that 10 grains from a healthy plant of wheat might weigh as much as 60 grains from one rusted heavily Wheat attacked by black rust contains more crude protein and less of starch than wheat free from rust



1 A leaf showing yellow rust
2 A leaf showing brown rust
3 Part of a stem showing black rust
4 An ear showing black rust
5 Normal wheat grains X 1½
6 Wheat grains from a badly rusted plant X 1½

B In India—No reliable figures are available in this country regarding the total loss caused to wheat by rust much less by each type of rust Such data might be forthcoming from crop cutting experiments which are in progress under a scheme of the Indian Council of Agricultural Research

Unfortunately in the greater part of the wheat area all the three rusts are fairly common in the south yellow rust does not appear in the plains owing to comparatively warm weather but it is present in the Nilgiris and the Palni hills because of their high altitudes

In the year 1903 Butler stated that probably 40 million rupees is not above the annual loss to India Since then the price of wheat has increased 5 to 6 times and to that we must add the loss suffered by the barley crop which covers nearly 6 million acres in the dominion of India.

An overall loss of 7 to 8 per cent in the yield would be a safe estimate considering the fact that owing to much earlier appearance of rust in the plains of Peninsular India the crop there suffers for a longer period Reckoned at that figure the damage caused to wheat and barley for the revised acreage after the partition of the country and at current prices would come to *more than 200 million rupees per year*

In addition the damage caused in abnormal rust years when the disease assumes the form of an epidemic over large tracts of the country may easily reduce the total yield by 15 to 20 per cent or even more For instance in the year 1944 the Central Provinces had a very severe epidemic as a result of which there was acute shortage of seed for the following crop The epidemic of 1947 was a national disaster resulting in the loss of nearly 2 million tons according to official reports This meant destruction to the tune of one fifth of the total yield of wheat from the undivided India The attack started from the south and spread to the Central Provinces Central India and Rajputana and later even to the south western districts of U P the analyses of rust collections showed that the predominant physiologic races that year were the same in all the parts of the country mentioned above

7 Four germs of black rust (magnified nearly 600 times)
8 Three germs of the above (magnified nearly germinating 600 times)
9 Part of a leaf of wheat showing the entry of a germ by a long tube (diagrammatic)
10 Part of a leaf of wheat with two blisters of black rust, highly magnified and showing scattered germs

C Epidemiology—Whereas there is a correlation between warm growing seasons and destructive epidemics there are no specific meteorological conditions or a set of conditions that always accompany epidemics This observation was made by Lambert on the strength of data for a period of 22 years from several stations in the U S A

According to Stakman and several other contemporary workers from different parts of the world the most important factors that are responsible, in general for the development of an epidemic are—

(*i*) Presence of considerable quantities of inoculum (infective material) rather early in the growing season of the crop

(*ii*) Favourable weather conditions (moisture and temperature) for the germination of spores and entry of germ tubes into the host plants

(*iii*) Favourable weather (temperature and light) for the rapid development (short incubation) of successive crops of uredospores

It is very likely therefore that in the presence of most of these factors over large tracts of a country in any season the crop may suffer from an unusually heavy damage

IV METHODS OF CONTROL

A Eradication of the Alternate hosts—Since the discovery, by approved scientific means of the connection between the black rust of wheat and the rust on *Berberis* by De Bary (1865) legislation for the destruction of this plant, which used to be grown as a protective hedge round the grain fields has been enforced in various countries

In the year 1918 a big barberry eradication campaign was started in the U S A and till 1934 six million dollars had been spent on this project by now the cost might have reached the 10 million mark As a result of this direct method of control there has been a considerable mitigation of the loss caused by black rust in the eradication areas As explained by Stakman (1934) and in his subsequent reports barberry eradication will not entirely eliminate rust from that country beacuse of two other sources of inoculum, Southern Texas and Mexico where the uredo stage is able to overwinter

Eradication of *Thalictrum* the alternate host of brown rust of wheat, has not been attempted anywhere because it is propagated from season to season by uredospores even in temperate climates

For the reasons explained above eradication of neither of the two alternate hosts is called for in this country and that means a saving of colossal sums of money which would otherwise have been necessary to spend on the destruction of millions of barberry bushes and wild plants of *Thalictrum* from the hills

B Cultivation of rust resistant varieties—This is undoubtedly the best method of control in the long run and a considerable amount of mitigation of the loss has been achieved in different countries by its application

Arising out of the results of investigations on wheat rusts at Simla and Agra the Indian Council of Agricultural Research sanctioned a scheme in the year 1935 for the breeding of resistant varieties of wheat for cultivation in the hills, wherefrom rusts are disseminated to the plains year after year This work has been in progress at Simla in collaboration with the Head of the Division of Botany at the Indian Agricultural Research Institute New Delhi

Owing to annual recurrence of all the three rusts in Northern India and over a considerable part of the Central Provinces only such varieties would meet the requirements as can resist each rust comprising the different physiologic races Judging from the severe tests to which the progenies of crosses are subjected the results obtained so far are very promising.

There are two other schemes of research for the selection and breeding of varieties mainly resistant to black rust Work under these schemes has been in progress for several years at Mahabaleshwar and Hoshangabad (C P) and they are both partly financed by the Indian Council of Agricultural Research

C Use of fungicides—Various chemical compounds have been used for spraying and dusting the wheat plants inoculated in glasshouses to test their efficacy in controlling rust Dusting with sulphur powder, specially the preparation called Kolodust, has given the best results in glasshouse experiments as well as field trials when the crop was dusted from aeroplanes

This method will remain impracticable for a long time in a country like India because of small holdings, enormous cost and also in view of, (*i*) the shortage of petrol air craft and technicians, (*ii*) prevailing dry weather during the period of growth of the crop as a result of which most of the sulphur dust is likely to be blown off and (*iii*) the need of weekly applications It is important to note that this method has been found to be effective only if dusting be done before the infection of crop and if the plants remain covered with the powder which should be very fine

D Elimination of the inoculum—Whereas this method would be of little value in temperate climates where brown and yellow rusts can survive in the uredo stage or as mycelium practically in the whole of the wheat area during the short period (hardly 2 to 3 months) between the harvest and the following sowing it has a special importance in this country because of the absence of the inoculum from the previous crop over 95% of the total acreage under wheat and barley, *i.e* in the plains This is due, as explained above, to the intense heat of summer

In temperate climates black rust starts every year from the barberries as a result of infection caused by the germination of the resting spores in spring In India black rust, like the other two, is reintroduced from the hills year after year where it survives in the uredo stage

The best way of eliminating the inoculum from the source is 'clean-up', destruction of out of season plants, rattoon tillers from harvested plants etc , on which rusts oversummer in the hills of India During 1942 48 experiment of rust control was tried in the hills of the United Provinces and Central Nepal with a small staff only ten Agricultural Inspectors and an equal number of fieldmen During the period of this experiment the Government of Nepal postponed, at my request through the proper channel, the August-September sowings to October, the normal period and a fair amount of propaganda was carried out through leaflets giving necessary instructions to the cultivators Whereas with the staff that was available satisfactory clean up could not be done, particularly on the isolated hill tops and localities difficult of access during the monsoon, eradication of the out of season' plants was carried out in the valleys and places of intensive wheat and barley cultivation The results were promising in so far as

(i) the incidence of rust was appreciably less each year on the *rabi* crops in the plains of U P and no epidemic occurred notwithstanding the serious epidemic of 1944 in the Central Provinces Even in 1947 when the bulk of the wheat crop suffered a heavy damage from rust in Peninsular India, C P Central India and Rajputana, U P had a light incidence till the middle of February As a result of dissemination of the inoculum by south westerly winds and late rains the crop in some of the districts of U P suffered a considerable loss Analyses of rust collections from Peninsular India the central parts of the country and the U P showed a striking similarity of the physiologic race flora and therefore left no doubt regarding the source of the inoculum

(ii) On the whole dates of initial rust attack were delayed, particularly in the eastern districts bordering the foot hills of Nepal

It is interesting to note that there was a big variation in the number of places in the hills where rust was found to oversummer during the 'clean up' period (June to September) from year to year taking all the altitudes together , the lowest percentage was one and the highest nearly twenty

Considering the fact that most of the fields following the harvesting of wheat and barley in the hills are utilized for *kharif* crops (maize and *Eleusine etc*) and the small size of the individual holdings (narrow terraces) clean up can be carried out by the cultivator and his family in a few hours and special labour is required only in the valleys of intensive cultivation Supervision of clean-up can easily be done by the seed distribution staff and persons connected with rural development of the areas concerned

It is of the utmost importance to remember that even when rust resistant varieties are available for cultivation in the hills of India the rust inoculum shall have to be eliminated therefrom' because, as recorded by Stakman, even highly resistant wheats get heavily rusted under cloudy weather and in the presence of large numbers of spore conditions of frequent occurrence in the hills

E Regulation of Crops—It is my considered opinion that this measure of prevention of rust should give the best results keeping in view all the facts concerning the Indian problem

It is absolutely necessary, therefore, that sowings of wheat and barley during *summer* (April to September) in the hills, hilly tracts and plains of Peninsular India be stopped by strict legislation imposing, if need be, a penalty of Rs 100/ or so for every acre or a part thereof For a more effective elimination of inoculum clean up should also be carried out at altitudes of nearly 3000 ft and above where black rust, at any rate may oversummer occasionally

This measure should go a long way to remove the most obvious factor of *very early* outbreaks of rust in Peninsular India

For the prevention of rust in the Indo Gangetic plain as well as the central parts of the country replacement of wheat and barley by varieties of oats, fit for human consumption in the hills and hilly tracts of U P Central Nepal and C P would be the best measure Oats are not affected by any of the wheat rusts and should therefore give a better yield than wheat and barley in the hills Besides, the most important achievement of this measure would be the automatic control of wheat rusts in the hills wherefrom they are at present disseminated to the plains year after year and cause an acute recurring shortage of one of the most essential food grains even when there is no severe epidemic

V CONCLUSION

With a deplorably low yield of 8 maunds to an acre, and now the average may be still lower as some of the highly yielding parts of West Punjab have gone over to Pakistan, an all out effort is necessary to remove the causes of this poor outturn In the latest number (October 1949) of 'World Crops' it was recorded that in U K 21 3 cwt of wheat were obtained per acre from this year's wheat crop which meant an increase of 2 6 cwt over the last 10 years' average, the present yield works out at a little more than 28 maunds per acre In the U S A this year's crop gave over 5000 million bushels as against that, our average yield now would be less than 7 million tons

Fortunately our Government at the Centre as well as in the Provinces and State Unions are making serious efforts to step up production by a drive for better manuring of the soil, which is highly impoverished, by providing additional facilities for irrigation and better quality seed Very recently the Food Production Commissioner with the Government of India announced that 8 lac additional acres of land will soon be put under cereals and that the target for additional food is fixed at 4 4 million tons This is good news and we are all very much interested in the success of every effort in this direction

With the decision on the part of the Government to achieve self sufficiency in the matter of food by the year 1951 in order to stop imports, and rightly too, we are in a period of emergency We cannot, therefore, afford to be complacent and reconcile to the loss of 6 to 7 lac tons of wheat and barley per year caused by rust, this loss may be doubled or even trebled in any year when there is a serious epidemic over large tracts of the country as has happened in the past, particularly in the year 1947

I was told that the experiment of rust control in the United Provinces was discontinued because the Central Government were considering a bigger project for the country as a whole The present position is that since April, 1949 legislation has been in force prohibiting the cultivation of wheat and barley during summer in Peninsular India and the result of the experiment should be available by the end of February, 1950, I am unable to discuss any details at this stage Nothing is being done by way of control as far as the United Provinces and the central parts of the country are concerned As far as I know seed of such varieties of wheat as are resistant to at least one of the three rusts may be available within the next 2 3 years in order to save the crop, at least partially in the event of an epidemic of only one rust or the other in the different parts of the country Without prejudice to any of the measures which the authorities may decide to enforce and realising the full value of varieties which can resist all the three rusts I make bold to suggest that adequate protection of the wheat crop in this country shall not be achieved unless we tackle the parasites at the source The maxim that 'Prevention is better than cure' is worthy of very early application by the destruction of the inoculum in the hills, this will have to be done even when resistant varieties are available, as stated above Why not do it now and reduce the deplorable deficit in the yield from year to year?

With strict enforcement of the prohibition of the summer crops of wheat and barley in Peninsular India and by the replacement of these crops in the hills and hilly tracts, which are acting as foci in the north and potential foci for the central parts of the country, by oats, fit for human consumption, we should get another 3 to 4 lac tons in the very first year even by 50% mitigation of the loss Besides, the danger of serious epidemics will be largely averted.

The measures discussed above are not likely to be expensive, in my opinion the cost should not exceed a sum of 3 lacs of rupees per year which is insignificant considering the probable gain and the gravity of the food shortage The situation calls for an enterprise, by no means great or hazardous, and a fair trial under adequate arrangements of supervision I hope this will soon be done

I take this opportunity of expressing my warmest thanks to the Indian Council of Agricultural Research under whose auspices investigations on the problem under discussion have been continued for the last 20 years or so and to the authorities of the Agra College, Agra for the various facilities provided in this connection My thanks are also due to all the scientific assistants who have rendered valuable help during the course of this work I am grateful to those officers of the Department of Agriculture, Central as well as in the Provinces and States who have extended time to time, their kind co operation in various ways

LITERATURE

For fuller information on the various topics discussed above the reader may consult the following publications and the references quoted therein

The Plant Rusts by J C Arthur and his Collaborators (1929)
Der Schwarzrost by E Lehmann, and H Kummer (1937)
Further studies on Cereal Rusts in India by K C Mehta,
The Cereal Rusts by K S Chester, (1946)

W. F. GIAUQUE

NOBEL LAUREATE IN CHEMISTRY FOR 1949

THE recipient of the Nobel Prize in Chemistry this year, Prof W F Giauque though by profession a chemist, being the Professor of Chemistry in the University of California, is in practice much more a physicist than a chemist In fact his career is checkered by a variety of interests Like Prof Kapitza he started as an engineer but was attracted to G N Lewis famous Berkeley school and turned into a Physical Chemist and ultimately earned his fame by his work in Low Temperature Magnetism It may however be mentioned that he remained faithful to chemistry by invariably publishing his papers in the *Journal of the American Chemical Society*

His earlier work on the discovery of the isotopes of oxygen though interesting by itself is very little known in comparison with his valuable works on Low Temperature Physics, in particular his classical discovery of the possibility of producing temperatures below 1 K by the method of adiabetic demagnetisation which claims perhaps the greatest public appeal After Onnes Keesom and others had practically reached the limit of human resources in attaining temperatures below 1°K by utilising as much as possible of the entropy or the internal disorder still left in liquid helium it was almost simultaneously pointed out by Giauque in America and Debye in Germany that temperatures as lower as about 32 milli degree Absolute could be reached by utilising the disorder of the electronic magnetic moments of certain paramagnetic salts A modification of the same method has led Simon and others to utilize the nuclear moments to generate temperatures of the order of 10^{-6} degree Kelvin In order to verify these predictions and pursue further his interest in low temperatures Giauque in collaboration with Prof Goetz built up a cryogenic laboratory at the California University which was the first of its kind in U S A The work of Giauque and his students on the paramagnetic salts at low temperature has further helped establishing the temperature scale below 1 K on a sound thermodynamic basis His invention of carbon resistance thermometer for this range of temperatures is typical of the simplicity and ingenuity involved in his experimental techniques

Prof W F Giauque

From the theoretical point of view even more instructive are his studies on the paramagnetic susceptibility specific heat and other properties at extreme low temperatures and none the less wellknown are those on thermo and spectro chemistry All these works in the ultimate analysis *gravitate* round his attempts to arrive at a better understanding of the laws of thermodynamics and their applicabilities at these extreme low temperature in which he has been eminently successful and the present award which has come none too soon will be appreciated on all hands

A B

Notes and News

ANNIVERSARY MEETING OF THE BOSE INSTITUTE

The 32nd Anniversary meeting of the Bose Institute was celebrated on 30th November, 1949 under the presidentship of H E Dr K N Katju, Governor of West Bengal when Dr K C Mehta, Principal and Professor of Botany, Agra College, Agra deliverd the Eleventh Acharya Jagadish Chandra Bose Memorial Lecture on 'Control of Rust Epidemics of Wheat in India— a National Emergency' which was illustrated with lantern slides and maps See p 263

In presenting his report the Director Dr D M Bose reviewed the principal events of the past year He stated that to meet the increased demand for additional accommodation, the construction of a laboratory of floor space 5400 sq ft area above the Hall of the Institute has been undertaken at an estimated cost of Rs 1,00,000/ The Trustees of Sir J C Bose Trust have generously placed at the disposal of the Governing Body of the Bose Institute a donation of Rs 50 000 to be known as "Sir J C Bose Contribution towards the objects of the Institute and which the Governing

Body has earmarked for the construction of the proposed laboratory To meet the balance of the cost of the construction the Government of West Bengal has been approached for a capital grant of an equal amount This total amount will not be sufficient to completely equip the laboratory a hope was expressed that other donations will be forthcoming for this purpose The Director outlined further the building programme of the Institute The Government of India have given a non recurring grant of Rs 1 00 000/ for implementing some of the recommendations of the Vallarta Reviewing Committee which at the instance of the Central Government visited the Bose Institute during March 1948 This amount is being utilized for the purchase of necessary workshop machineries and scientific apparatus He announced that a grant of Rs 60 000/ for a three years investigation on X ray irradiation on oil seeds with a view to obtaining new mutants with improved economic characters has been sanctioned by the Indian Oilseed Committee A grant of Rs 6 000/ has been received from the Burmah Oil Company (India Concessions) Ltd on certain palaeobotanical investigations which may throw some additional light on the controversial topic of the Age of the Saline Series in the Salt Range Punjab Grants as received in previous years from the B R A F C S I R I C J C and the Cotton Committee of West Bengal are being continued and the total amount received exceeds the present recurring grant of Rs 1 00 000 received from the Central Government

In reviewing the research work of the Institute the Director mentioned that special importance is being given to the training of the younger research workers in modern technical methods like the use of high frequency techniques of powerful source of ultrasonic vibration paper chromatography and of radioactive tracers He referred to an interesting result observed in January 1949 of an increase in cosmic ray intensity associated with an intense sunspot activity This phenomenon of rare occurrence is not expected to be observed at the low geomagnetic latitude of Calcutta He mentioned that a monograph will soon appear in the *Transactions* of this Institute in which the Founder s Plant Physiological investigations in relation to modern biological knowledge is reviewed In the year under review special attention was being given to the Founder s investigations on the responses in the living and the non living These have acquired a new significance due to the appearance during war and post-war periods of automatic machines which can open *e g* doors by means of photoelectric cells points gun to the place where a radar picks up an air plane or compute the solution of a differential equation These automata contain like animal organisms sense organs effector mechanism by which the sensory messages received are converted into effective actions and the equivalent of a nervous system These activities can very well be described in physiological terms Recently a common science of communication and control including both machines and living organisms is growing up for which the name Cybernetics has been coined by Wiener

The claim of J C Bose with his pioneer studies of half a century ago on the common principles underlying responses in the living and the non living to be considered as precursor of Cybernetics was discussed by the Director He further mentioned that according to present ideas both in animals and in plants behaviour is based upon a series of inter related biochemical processes released and controlled by external stimulation transformed into electric excitation in the receptor organs Certain chemical substances are active as mediators in these biochemical changes of which a theory has recently been worked out in the Institute in whose biochemical laboratory one of these mediators responsible for the initiation of mechanical response in sensitive plants is being intensively studied

Addressing the gathering Dr Katju said that scientific research in India should now be directed towards a solution of the country s many problems particularly those relating to the provision of food shelter and clothing The people could only interest themselves in the work of organizations like the Bose Institute if the latter could produce tangible results —not in the course of centuries but within a measurable period of time

The Institute s work in connexion with plant breeding were of great importance today because as a result of partition greater emphasis had now to be laid on cotton and jute cultivation in India

The Governor emphasized the need for more experimental stations where the results of research work could be thoroughly tested before being applied to every day use

Paying his tributes to the memory of Acharya Jagadish Chandra Bose His Excellency said the pioneer efforts of the founder of the Institute had helped to explore the myth that Indians were more efficient in metaphysical than in scientific research

CONTROL OF WHEAT RUST A NATIONAL EMERGENCY

Elsewhere in this issue we have published the full text of Prof K C Mehta s Eleventh Acharya Jagadish Chandra Bose Memorial Lecture at the Bose Institute Calcutta on Novenber 30 last ¹ On the basis of ruling prices for wheat and barley India is losing annually Rs 20 crores through damage caused to these crops by rust epidemics Sometimes when the epidemic breaks out in serious form and is spread over large areas of the country the loss may reach the fantastic figure of Rs 40 and Rs 60 crores as happened in 1947

In India black stem rust occurs everywhere and the brown is also fairly common whereas the yellow rust is not found in Peninsular India as it thrives only under comparatively cool conditions Black and yellow rusts also attack barley The heat that follows the harvest kills the uredospores of all the rusts in the plains, in general but in the hills they oversummer at different altitudes on stubble volunteer wheat and out of season crops where grown Wind disseminated spores from the hills particularly those from Central Nepal in the North and the Nilgiri and Palni hills in the South are responsible each year for infection in the plains

Year after year rust breaks out in Peninsular India 2 3 months earlier than in the northern plains Since last year legislation has been enacted to prohibit sowing of wheat during summer months in Peninsular India and the result of the experiment would be available by the end of February 1950

Nothing is being done to control rust in the Indo Gangetic plain and the central parts of the country For this purpose the best and the most inexpensive measure would be to replace wheat and barley in the hills and hilly tracts of the north and the central parts of the country by oats fit for human consumption Oats are not affected by any of the wheat rusts

Without prejudice to the cultivation of rust resistant varieties when available or even of partially resistant wheats the above measures should considerably mitigate the huge loss as a result of elimination of inoculum from the source *i e* the hills

NEW VENTURE IN COALFIELD GEOLOGY

It is encouraging that research workers in India are in close pacing with their colleagues abroad The recent attempts of Messrs A K Ghosh and J Sen to correlate a few coal seams with help of microspores in coal in the disturbed eastern part of the Raniganj coal field is a pioneer venture

The last few years have witnessed immense and diversified development of Micropaleobotany in Europe and America by its application to the problems of stratigraphy paleoecology paleogeography and phylogeny Thiessen s achievements in U S A and Raistrick s new ideas of correlating coal seams in U K have developed into thoroughly practical method Following these workers Messrs Ghosh and Sen have opened in India a new field of investigation on the economic possibilities of microfossils

These authors have recovered innumerable types of new spores wood fragments cuticles and *incertae* structure from coal samples collected from the six seams on either side of Bonbishtopore—Mohisilla cross fault on the basis of which correlations are suggested between these seams

A *Ptiyosporites* microflora highly characteristic of all the seams examined and from rocks of remote parts of the Gondwanas, has been recognised as a contrast to the English Coal Measure microflora The presence of different classes of plants in the coal forests of Raniganj and the climate prevailing during the growth of such vegetation have been discussed (See (*Trans Min Geo Met Inst Ind 43* 67 95 1948)

It is now becoming increasingly evident that except a few isolated attempts by the workers in the Calcutta University very little work has been done in India in this line (See *Science* and *Culture 14* 510 1949) Before his untimely death the Late Professor Birbal Sahni did much to establish the usefulness of microfossils as age and horizon markers of sedimentary rocks other than coal and suggested a systematic survey of the paleobotany of Indian coal Only recently the Fuel Research Institute at Dhanbad has taken interest in this line The work is heavy and as such it is desirable that workers in the Universities should have adequate facilities to work simultaneously and in collaboration with the Birbal Sahni Institute of Paleobotany the Fuel Research Institute and the Geological Survey of India

MAGNETIC MOMENT OF THE PROTON

The magnetic moment of the hydrogen nucleus or proton has been accurately determined in absolute units in the atomic physics laboratory at the National Bureau of Standards When combined with other data this work gives a precise absolute value for the electron charge to mass ratio *e m* The gyromagnetic ratio of the proton from which the magnetic moment was obtained has been accurately determined by measuring the magnetic field and radio frequency required for magnetic resonance absorption in a proton sample This is the first precise determination of the proton moment in absolute unit all previous measurements approaching this precision have been made in terms of the relative values of other physical constants

The new measurement provides an accurate secondary standard for magnetic fields In the past laboratory measurements involving both magnetic and electric fields have been limited by the low accuracy of the magnetic measurements Now the situation is reversed and magnetic fields can be measured more accurately than electric This advance will be especially useful in the design and development of scientific and industrial apparatus employing magnetic fields where it is important to know accurately the special distribution of the field

The nuclear resonance techniques developed in the course of this work can be applied to good advantage wherever the strength of a magnetic field must be regulated The problem of magnetic field regulation arises widely in the use of scientific apparatus such as cyclotrons mass spectrogrphs and beta ray spectrometers and in industrial equipment such as servomechanisms and electromagnets (*Journal of the Franklin Institute* October 1949)

POISONOUS EFFECT OF BERYLLIUM

A new explanation of the mechanism of beryllium poisoning which may open the way to development of an effective treatment was offered at the American Chemical Society s national meeting

Beryllium a hard, light weight metal used in the manufacture of fluorescent lights and in many other industrial applications has been found to interfere with the body's use of sugar and other foods of the carbohydrate family* according to a report presented by Dr Kenneth P DuBois of the University of Chicago Toxicity Laboratory Entering the body chiefly through the respiratory tract in the form of dust beryllium causes serious lung damage that persists and grows progressively more severe and it can also produce bone cancer rickets and a general failure of metabolism

Beryllium's industrial importance has increased greatly in recent years because of the highly valuable properties of its alloys particularly the copper beryllium alloys The chances for exposure to beryllium dusts are fairly numerous in industry and may be encountered during virtually all stages of beryllium production

Beryllium might interfere with chemical reactions essential for normal metabolism said Dr DuBois who also found that beryllium interferes with carbohydrate metabolism A rapid rise in blood sugar occurred after injection of beryllium and a depletion of the carbohydrate reserve (glycogen) occurred In addition there was a striking alteration in some of the phosphorus compounds of tissues which are involved in carbohydrate metabolism Phosphocreatine which is an important compound for the energy yielding reactions of tissues was depleted and there was a marked shift in the ratio of organic to inorganic phosphorus resulting from a breakdown of organic phosphorus compounds

In an investigation of the specific manner in which beryllium produces the above mentioned effects it was found that it competes with calcium and magnesium both of which are necessary for the breakdown of carbohydrate Beryllium appears to combine with the same compounds in the cell as do calcium and magnesium but cannot perform the biological functions of these metals and therefore blocks the sequence of normal chemical events in the cell

SODIUM TRIFLUOROACETATE

A new fluorine compound sodium trifluoroacetate (F_3COONa is now available in pilot plant quantities in U S A for appraisal by the chemical industry It is a white odourless non corrosive and free flowing powder The new salt is non toxic and is very stable up to 300°C It is resistant to hydrolysis and is not attacked by aqueous alkali at the boiling point The commercial grade of sodium trifluoroacetate usually has a purity of 98 99 per cent the most common impurities being sodium chloride carbonate and sulphate and traces of moisture The salt is freely soluble in water at room temperatures fairly soluble in ethyl and methyl alcohols and also methyl ethyl ketone slightly soluble in ether but insoluble in benzene carbon tetrachloride and perchloroethylene Prominent among its reactions is its conversion to ethyl trifluoroacetate by treatment with ethyl alcohol and sulphuric acid This ester can then be reacted with ammonia to form trifluoroacetamide

The physical and chemical properties of the salt suggest its use as an intermediate in the preparation of herbicides insecticides and dyestuffs and as a condensing agent The chief value lies in its readiness of conversion to trifluoroacetic acid which is the starting off point for a number of important reactions This acid is as highly ionised as hydrochloric acid It fumes in moist air and its azeotrope with water boils at 105 5°C and contains 79 4 per cent trifluoroacetic acid (*The Chemical Age* October 29 1949)

A NEW PLASTIC FOR INDUSTRY

A polymer of trifluorochloroethylene now produced commercially in the U S A appears to offer important advantages over polytetrafluoroethylene as a material for fabricating parts of chemical plants such as valve sets valve packings pump packings and diaphragms chemical pipe tubing and gaskets as protective coatings on chemical processing equipment and containers and as collapsible bags for the storage of liquid fuels including fuming nitric acid

The new polymer has a high resistance to chemical attack No effect has been observed after prolonged exposure to concentrated sulphuric hydrofluoric and hydrochloric acids to strong caustic to fuming nitric acid aqua regia and other vigorous oxidising agents It is equally resistant to most organic solvents but is slightly swelled and plasticised by highly halogenated materials and some aromatics The plastic is currently supplied in three different grades representing three different molecular weights

It has been shown by extensive experimental work that this plastic can be moulded by compression injection transfer and extrusion methods with conventional equipment The plastic can also be machined easily and the head sealed The plastic is remarkably amenable to heat treatment thus it may be made relatively soft and resilient resembling a plasticised material or harder and less yielding without expensive processing The new fluorine polymer can be made transparent or translucent to visible light as desired It is also sufficiently transparent to longer wave lengths for use as a window material in the infra red region

Rapid cooling or quenching of the plastic moulded material through 400° to 300°F temperature range produces both transparency and flexibility proportionate to the rate of cooling Quenched 1/16 in sheet is almost perfectly transparent while 1/8 in sheet has slight blue haze This is due to light scattering by crystallites and is a condition that becomes progressively more apparent in thicker sections from which transmitted light has a noticeably yellow or pink colour

Polymers of trifluorochloroethylene do not possess very outstanding resistance to heat and as an average the temperature range is from —320°F to 375°F So far it has found its main uses in the electrical industry as insulation and wire coating and condenser foil for applications under corrosive conditions at extended temperature ranges in motors, transformers, control instruments etc (*The Chemical Age* October, 29, 1949)

CHLORDANE REPLACES DDT

That the insecticide chlordane is more dangerous than DDT to warm blooded animals, was indicated in a recent report of the American Chemical Society

Although the single dose of orally administered chlordane necessary to kill a laboratory rat or rabbit was about the same as a lethal dose of DDT, chlordane proved to be the deadlier chronic poison E F Stohlman and Maurice I Smith of the National Institute of Health, Bethesda, Maryland stated

Post mortems on rabbits killed by chronic chlordane poisoning revealed that the liver and kidneys had degenerated, the report said, whereas in acute poisoning the most characteristic signs were flooding of the lungs with fluid and inflammation of the intestines The powerful sedatives sodium amytal and sodium pentothal, afford "a considerable degree of protection against large doses of chlordane given intravenously by hypodermic injection, it was noted Chemical analysis of the urine of rabbits receiving small oral doses of chlordane daily revealed that significant amounts of the insecticide are linked with other organic chemicals and then excreted, the chemists reported explaining that this analysis 'may be used as an aid in the diagnosis of chlordane poisoning and in the prevention of poisoning under continued exposure

CALIBRATION OF PHOTOGRAPHIC LENS MARKINGS

In the course of an experimental study of errors in the speed markings of photographic lenses scientists in the optical instruments laboratory of the National Bureau of Standards have devised a convenient graphic method for converting each of these markings for a given lens to the corresponding 'effective *F* number,'—an *F* number corrected for light losses within the lens In this way it is possible to calibrate a lens so that losses of light from absorption, reflection, and scattering within the lens are taken into account, and a more accurate control of the amount of light admitted to the exposed film is obtained

The method now in use for speed marking of lenses is based entirely on the ratio of the equivalent focal length of the lens to the diameter of the aperture This ratio—known as the *F* number—gives no consideration to the great differences in the useful light transmitted by various lenses

The Bureau has also developed a method of testing the marked diaphragm openings so that values that entirely compensate for differences in transmission can be obtained and applied to the scale of *F* numbers on a photographic lens In this system the markings, known as effective *F* numbers or t numbers, are obtained by means of a photoelectric cell and a relatively simple photometric procedure in which the diaphragm of the lens to be calibrated is adjusted to transmit the same amount of light as a similarly placed opening of standard size The standard opening corresponds to an ideal lens of a given aperture ratio, in which incident light is wholly transmitted A complete calibration is obtained by the use of a series of openings of graduated size corresponding to various aperture ratio values (*Journal of The Franklin Institute* October, 1949)

BOTANICAL SURVEY OF INDIA

Report of the Botanical Survey of India for the year 1947 48 just published will no doubt indicate that the affairs of this Survey were not being attended to in the right way No blame attaches to the officers of this Survey as the Survey in fact exists in name only with one officer maintained by the Government of India at its headquarters at Sibpur and now superannuated and another officer who is in charge of the Industrial Section of the Indian Museum The entire Royal Botanic Gardens and its Herbarium at Sibpur have been maintained by the Government of Bengal for the benefit of the whole of India now for more than a century and a half Repeated endeavours in the past to develop the Survey failed And the last attempt to revive it was in connection with the post-war plans of the Government of India The Report of the Botanical Survey referred to above says that botanists were admitted to be trained for the survey work of India s unknown flora Unfortunately, a later decision by the Government to suspend the expansion of the Survey have led these trained men to seek jobs elsewhere resulting to a waste of scientific manpower trained by a National Government! As in the case of India s Geology India s Botany is also meagrely known It is all the more distressing when one notes that botanists from far and distant countries are constantly hunting for Indian plants and we are yet unconcerned over the matter The Survey should begin to work at once for the future benefit of India's science and industry The activities of this Survey which is now confined to carrying out the routine work and for minor Survey work with its limited resources deserve commendable encouragement by the Government and the public We had occasion to write on this subject earlier and stressed the urgency and importance of the Survey of the flora of India (See Science and Culture, *11* 1945, 105, 109, *14* 393)

FOOD AND PEOPLE

A symposium on Food and People' was held under the auspices of the Botanical Society of Bengal at the Bose Institute, Calcutta on December 10 last and the different aspects of the problem of food and population in India with special reference to West Bengal were discussed by the speakers

Inaugurating the symposium Sj Prafulla Chandra Sen Food and Agriculture Minister West Bengal said that the food problem of the province should be fought on three fronts namely through increasing production changing the food habit of the people through propaganda and demonstration and introduction of subsidiary foods

Sj Sen said that afforestation must go hand in hand with reclamation of waste land Stressing the need for propaganda for changing the food habit of the people Sj Sen said that Government were thinking of opening model canteens where balanced dishes would be served with staple as well as subsidiary foodstuff He added that considering the food value of products compost manure was perhaps preferable to chemical fertilizers

Dr S L Hora Director Zoological Survey of India said that the problem of food had been accentuated because the intelligentsia had come away from the land An average fisherman in the western coast of America had a higher income and standard of living than a professor The experts in this country were not practical men Food problem was not the problem of Government offices it was the problem of the field Let some patriotic young men go to villages and till the soil he suggested The problem could be tackled that way only

Sj I Chatterjee lately Assistant Agricultural Commissioner Government of India said that the process of cooking rice in West Bengal resulted in a huge loss which worked out at about Rs 15 for every Rs 100 worth of rice If the milling process could be improved washing and throwing off of the rice water could altogether be avoided he stressed

Sj J P Bhattacharjee Economist *Visva Bharati* said that the ten per cent deficit in food production which Government of India was trying to wipe out by 1951 was not static The deficit would increase with the increase in population Problem of food would never be solved until they could solve the dynamic problem of population Not only the food resources of the country should be pooled together the population should be planned as well

Dr Purnendu Bose Lecturer in Statistics Calcutta University said the amount of food deficit in the province was almost the same today as was in the prewar period Inflation alone could not justify the present high prices of rice in the province

Dr A C Ukil Editor SCIENCE AND CULTURE said that the shortage of 10 per cent in cereals did not mean that the total food shortage in the country was 10 per cent The authorities were not taking into account the food requirements of the physique in calculating this deficit because they had hardly a food policy Food grown through the munificence of Nature must be supplemented by food produced in laboratories he suggested

Dr T J Job Fisheries Development Officer Government of India said that there was more food in water than in land and added that aquiculture must be developed along with agriculture

Dr A K Dutta Soil Erosion Officer, Damodar Valley Corporation stressed the need for harnessing research results to the actual augmentation of food production

Sj Jnananjan Neogy Editor *The Manufacturer* said that there was no dearth of available land even in truncated West Bengal The rural areas could still take in about 25 lakhs of people He suggested fish culture in paddy fields for increasing the yield of paddy

Dr K Biswas Superintendent Royal Botanic Garden Sibpur who presided referred to the problem of maldistribution of cereals and other products and suggested that regional distribution if possible district by district making each district self supporting as far as practicable might solve the problem of maldistribution and wastage to a certain extent There was really shortage of man power for future prosperity of India he said Dr Biswas added that they were cultivating fallow lands rather aimlessly without previous floristic analysis or field survey of the flora of the particular region Very little record was also being kept of the areas now being denuded of its original vegetation and being cultivated for highly domesticated cereals

Among others Sj F A R Benerji Dr H C Choudhuri Dr P Nandi Prof P C Sarbadhikari Prof S P Chatterjee and Prof P K Sen Gupta spoke at the symposium

Earlier Sri S N Sen Editor SCIENCE AND CULTURE and until recently on the staff at the UNESCO headquarters at Paris presented the UNESCO s viewpoint in sponsoring these symposia He said the UNESCO believed that a rightly directed educational campaign could considerably help by contributing to constructive public thinking

NEW NEOPRENE RUBBER

A new type of neoprene synthetic rubber has been produced in the organic chemicals department of E I du Pont de Nemours & Co Inc With the new polymer designated neoprene Type W it is now possible to produce vibration dampening devices which not only are highly resistant to oils heat grease and sun light but also exhibit as low permanent deformation as those made of natural rubber

Chemically similar to previous neoprenes its molecular structure has been modified in such a way that its mechanical properties are now more nearly like those of natural rubber Moreover the stability of this new polymer in the raw state is said to be superior It can be fabricated over a wider range of temperatures than that of previous types of neoprene, and shows much less tendency to stick to the milling rolls during processing operations In addition to low permanent deformation, neoprene Type W also has a low modulus Brighter and more attractive colours are possible with this new type of neoprene (*Chemical and Engineering News*, October 17 1949)

ATOMIC ENERGY LITERATURE

An International Bibliography on Atomic Energy has been prepared by the AEC Group of the Department of Security Council Affairs of the United Nations Secretariat The two volumes will constitute the first attempt to provide a comprehensive international bibliography on atomic energy Vol I is obtainable from Columbia University Press New York N Y at 50 cents a copy Vol II is now being printed and will be available in a month

POPULATION STUDY IN INDIA

The Government of India have agreed to a proposal of the United Nations to sponsor a joint study of the relationships between the social economic and population changes in India

The study will be conducted by a team of U N experts in collaboration with the Indian Health Home and Labour departments In the initial stages it will comprise investigations on fertility mortality and rate of population growth amongst various classes of people in India the extent causes and characteristics of inter regional and inter provincial migrations and economic development by better utilization of human and natural resources of the country

RAJASTHAN ACADEMY OF SCIENCES

The Rajasthan Academy of Sciences was inaugurated in Pilani on 27th November 1949 by the Hon ble Shri Siddharaj Daddha Minister for Industries and Commerce Rajasthan The Academy has been started to uphold the cause and progress of science both pure and applied in Rajasthan It shall in due course publish a *Journal* including articles of original research

At a meeting of the Foundation Fellows of the Academy Shri M L Schroff was elected *President* of the Academy for 1949 50 Dr B N Mulay *Vice President* and Shri K B Ramachandran Department of Botany Birla College Pilani *Secretary*

ANNOUNCEMENTS

Dr T M Harris Professor of Botany University of Reading U K has joined the Birbal Sahni Institute of Paleo botany Lucknow as Adviser

Sri Amal Home Director of Publicity Government of West Bengal retired from the Calcutta Corporation on November 9 last where he served as Founder Editor of the *Calcutta Municipal Gazette* since 1924 Sri Home was able to set up a well defined sphere in the extensive field of Indian Journalism and today every other city or town possesses a civic journal

Applications are invited for the Edward A Deeds Fellowship in University College Dundee for research in Engineering Metallurgy Chemistry Physics Mathematical Physics or any cognate subject The Fellowship (which is open to persons of either sex) is of the value of £ 750 to £ 1000 per annum and is tenable for three years The Fellow will have the status of a University Lecturer

Application should reach the Secretary University College Dundee from whom further particulars may be obtained not later than 31st March 1950

ERRATA

The following references may kindly be read after the article on Physical Methods of Testing Jute Fibre by Dr K R Sen appearing in pp 210 216 of the December 1949 issue

1 K R Sen Jute Bulletin Indian Central Jute Committee September 1947
K R Sen *Agriculture and Livestock in India, 1931*
3 H Navkal & K R Sen *J Text Inst Trans 1930*
4 K R Sen & N Ahmad *J Text Inst Trans 19 8*
K R Sen & N Ahmad *Ind Text Jour 1939*
6 K R Sen SCIENCE & CULTURE *October 1947*

LETTERS TO THE EDITOR

[*The Editors are not responsible for the views expressed in the letters*]

INDUSTRIAL WASTES DISPOSAL—TREATMENT AND UTILISATION OF TEXTILE WASTES

The problem of disposal of industrial wastes is assuming an increasing importance in India Particularly with the industrialization of the country and the concomitant improvement in sanitary conditions the urgency for the standardization of methods for safe disposal of these wastes with reference to Indian conditions cannot be over estimated[1] In other industrially advanced countries not only has considerable research been done in these directions but stringent regulations are also laid down by the State and observed by the industries in regard to the quality of the effluents they discharge necessitating proper treatment before the wastes are let into the sewers water ways or even into the sea Occasionally valuable materials are recovered from such wastes but generally the cost of treatment of effluents from any trade is reckoned as part of the cost of manufacture of goods

In our country the largest industry is the Textile Industry and it discharges millions of gallons of fluid wastes every day These wastes contain caustic al kali alkali carbonates and bicarbonates from kier boiling and mercerization operation and are highly alkaline the pH generally being between 8 and 11 They also contain large amounts of putrescible and non putrescible organic matter—degradation products of cotton fibre—partly in suspension and partly in colloidal and true solution A considerable amount of chlorides from bleaching sulphates from souring and unused dyestuffs from the dyeing operations are added to these The mixed wastes have a fairly high pollution effect as measured by their oxygen consuming capacity The necessity for their treatment and safe disposal is obvious especially in inland towns of India like Ahmedabad where there is a large concentration of textile mills

In other countries these wastes are treated purely from a disposal point of view Methods obtaining there include segregation of weak wastes from strong ones equalization to help mutual precipitation of chemicals present aeration and sedimentation Besides these treatments almost all wastes are treated with chemicals like alum ferrous or ferric sulphate to reduce the alkalinity While chemical treatments are most universal certain types of filters similar to trickling filters of sewage are employed particularly in England Generally coke breeze or coal ash is used in beds approximately 4 ft deep These different methods of treatment current in other countries are discussed by Hoover[3]

A simple and cheap method of treatment and utilization of these textile wastes worked out by the authors and adapted on a large scale at Ahmedabad is carried out in three stages

The first stage is the treatment of the wastes with gypsum a chemical easily and locally available The wastes from the different operations in the textile mill collect in a sum pit where they are allowed to mix and mutually react (equalize) *e g* the acid wastes partly neutralize the alkaline waters and the calcium chloride present neutralizes some of the alkali carbonates to form calcium carbonate The composite mixture of wastes is then pumped into reaction tanks treated with gypsum powder aerated for half an hour settled for three hours and the effluent discharged into the reservoir from where it is pumped into the sewers

It has been found that about 4 cwts of gypsum per 100 000 gallons of wastes are necessary and adequate Gypsum is available in the locality at about Rs 20/ per ton and so the cost of the chemical alone for treatment would come to about Rs 4/ per 100 000 gallons The gypsum reacts with the alkali carbonate in the wastes forming calcium carbonate However since a considerable portion of the alkali exists as an unstable mixture of hydroxide and bicarbonate and is slowly converted into carbonate there is only a slight amount of sludge formed The remaining amount of gypsum present serves, (*i*) to react later with the alkali present when it is converted into carbonate and (*ii*) to protect the cement pipe lines through which the wastes have to flow against corrosion by the alkali in solution During the reaction with gypsum there is a reduction in the alkalinity of the wastes as also in their oxygen consuming capacity as the precipitated calcium carbonate carries down with it some organic matter (Table I)

TABLE I

TREATMENT WITH GYPSUM BATCHES OF 25 000 GALLONS OF WASTES TREATED WITH 100 LBS OF GYPSUM POWDER

No	Description	cc N/100 acid for 100 cc		Ca in solution	Oxygen abs. in 3 minutes p p m
		pH alkalinity	M O alkalinity		
1	Original	40	68	0 6	38
	Treated	28	55	6 9	29
2	Original	56	97	0 4	47
	Treated	44	86	8 2	40

The sludge formed in the reaction tank is removed to a sludge well and dewatered on a sand bed The clear effluent is pumped into the sewers and goes to the pumping station along with the domestic sewage

Here the second phase of treatment occurs on admixture of sewage with the treated effluent in the ratio of 2 1 There is a further reduction in the alkalinity of the wastes due to dilution and to the presence of acidic gases in sewage It has been shown that no sludge or gas is likely to be formed in the brief period during which the mixture is conducted through the pipe lines to the farm It has also been found that the mixture progressively loses its alkalinity and becomes neutral in 12 36 hours Some typical results are given in tables II(a) and II(b) below

TABLE II (a)

REDUCTION IN ALKALINITY ON MIXING TEXTILE WASTES WITH SEWAGE

No	Description	cc N/100 acid per 100 cc		calculated pH alkalinity	pH alk reduction %
		pH alkalinity	M O alkalinity		
1	Sewage only	Nil	60	—	—
	Textile waste	40	108		—
	Sewage t w 4 1	2 0	74	8 0	75 0
	„ , 2 1	7 8	81	13 3	41 0
2	Sewage only	Nil	74	—	—
	Textile waste	23	52	–	–
	Sewage t w 4 1	Nil	61	4 6	100
	, , 2 1	3 4	64	7 2	55 8

That the normal oxidation changes occurring in sewage are not interfered with by its admixture with the treated textile effluents (in the proportion indicated) has also been confirmed by a series of experiments Further these wastes act as a useful diluent to sewage

In the third and final stage of treatment the mixture is applied to land for raising of crops On

TABLE II (b)

REDUCTION IN ALKALINITY OF SEWAGE TEXTILE WASTE MIXTURE ON STANDING WITH TIME

No	Description	Phenolphthalein alkalinity as cc N/100 acid per 100 cc of mixture: Calculated	0 hrs	4 hrs	8 hrs	24 hrs
1	Sewage t w 2 1	13 3	7 8	3 8	1 2	Nil
	" " 1 1	20 0	16 2	14 0	11 0	6 2
2	Sewage t w 2 1	7 7	3 4	1 7	0 4	Nil
	" " 1 1	11 5	7 1	6 0	4 7	1 3

application to land whatever small quantity of alkali is present in solution is precipitated as the innocuous calcium carbonate by the gypsum present in solution That no harmful residual effects need be apprehended on continued application to soil and that crops can be raised on this mixture just as satisfactorily as on similar sewage tap water mixtures has not only been shown by pot experiments but also confirmed on a large scale by growing sugarcane on these mixtures for three years at Ahmedabad

So far 10 out of the 70 mills have installed purification plants and adapted the treatment at Ahmedabad and over a million gallons of textile wastes are being treated daily

The authors here wish to record their grateful thanks to the Council of Scientific and Industrial Research under whose auspices, these investigations have been carried out during the last four years

S BALASUNDARAM
V SUBRAHMANYAN

Department of Biochemistry,
Indian Institute of Science,
Bangalore, 8 3 1949

---

[1] Fowler G J *Science and Culture* 9 363 1944
[2] Hoover C R *Ind & Eng Chem* 31 1352 1939

OSCILLATIONS OF A CONVEX LENS ON A PLANE SMOOTH SURFACE

In connection with a new method of observing Lissajous' figures the author[1] made use of small oscillations of a thick bi convex lens on a plane smooth surface In the present communication the rocking motion of the lens is shewn to be periodic, but not necessarily always simple harmonic

Let an equi convex lens whose both spherical surfaces have the radius R, be placed on smooth horizontal xy plane, the point of contact P of the lens with it be taken as the origin and z axis be drawn vertically upwards, so that when the lens is at rest its centre of gravity G has the coordinates (0, O$_1$ h)

A moderate tap on the edge may be used to transfer the energy E to the lens, which sets it rocking from side to side Let the locus of the point P, which is a straight line, be taken as x axis. The plane of rocking will, therefore, be vertical xz plane Another point O which is the centre of curvature of the lower surface of the lens, has also got a rectilinear locus ox' parallel to the x axis at a distance equal to R

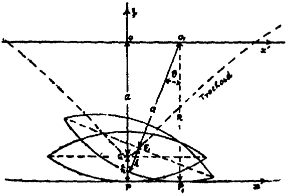


Fig 1

When the lens rocks from side to side the points P and O move to and fro along the rectilinear loci but the centre of gravity G traces and retraces the cusp of the trochoid which lies in the vertical xz plane The parametric equations of the trochoid the locus of G as referred to the above mentioned coordinates will be

$$\left.\begin{array}{l} x = R\theta \quad a\,\mathrm{Sin}\theta \\ y - 0 \\ z \quad R \quad a\,\mathrm{Cos}\theta \end{array}\right\} \qquad (1)$$

where $a = R - h$ (GO $-$ G$_1$O$_1$)

In an instantaneous displaced position of the lens let the point of contact be P$_1$ and let the centre of gravity of the lens lie at G$_1$ on the cusp of the trochoid Let the moment of inertia of the lens about the instantaneous axis of rotation which passes through P$_1$ be I

Then by principle of conservation of energy neglecting the losses due to friction and air damping etc, we have the equation

$$\tfrac{1}{2}\mathrm{I}\,\theta^2 + a\,(1 \quad \cos\theta)\,mg \quad \mathrm{F} \qquad (2)$$

where m is the mass of the lens and g the acceleration due to gravity

Now $\mathrm{I} - m(k^2 + \mathrm{G_1P_1}^2)$

Using equation (1) to get G$_1$ P$_1^2$, we have

$$\mathrm{I} = m(k^2 + a^2 + \mathrm{R}^2 - 2a\,\mathrm{R}\cos\theta) \qquad (3)$$

where k is the radius of gyration of the lens about axis through G parallel to the instantaneous axis of rotation, and is given by

$$k^2 = \mathrm{R}^2 \frac{\left(\frac{4}{15} + \frac{1}{4}\cos\alpha + \frac{2}{3}\cos^2\alpha - \frac{13}{6}\cos^3\alpha + \frac{59}{60}\cos^5\alpha\right)}{\left(\frac{2}{3} - \cos\alpha + \frac{1}{3}\cos 3\alpha\right)} \qquad (4)$$

where α is the semivertical angle of the cone subtended by the periphery of the lens at the point O, the centre of curvature of the spherical surface

Writing $A = k^2 + a^2 + R^2$ (5)

and putting the value of I from equation (3) in equation (2) we have

$$\tfrac{1}{2}(A - 2aR\cos\theta)\,\theta^2 + (1 - \cos\theta)ag = \frac{E}{m} \qquad (2)$$

which on differentiation yields,

$$(A - 2aR\cos\theta)\,\theta + aR\sin\theta\,\theta'^2 + ag\sin\theta = 0 \qquad (6)$$

This general differential equation of the rocking motion of the lens does not yield a periodic solution in all cases but relevant solutions corresponding to certain practical cases may however be obtained

If we consider the oscillations of small amplitudes then the position of G is always very nearly at the bottom of the cusp and we may put O as vanishing angle Therefore, using the approximation equation (6) reduces to

$$(A - 2aR)\,\theta + aR\,\theta^2\theta + ag\,\theta = 0 \qquad (7)$$

Case (i) As a first approximation we may neglect the second term in equation (7) in view of θ^2 and then we have the equation

$$\theta + \frac{ag}{A - 2aR}\,\theta = 0 \qquad (8)$$

which represents S H M with the well known solution

$$\theta = B\sin(\sqrt{\mu}t + \chi) \qquad (9)$$

where the constants B and χ are determined by boundry conditions and μ stands for $\dfrac{ag}{A - 2aR}$

Using equation (5) Period is given by

$$T = \frac{2\pi}{\sqrt{\mu}} = 2\pi\sqrt{\frac{k^2 + h^2}{(R - h)g}} \qquad (10)$$

Case (ii) Now retaining the term in θ^2 in equation (7) it may be written as

$$\theta + \nu\,\theta^2\theta + \mu\,\theta = 0 \qquad (11)$$

where $\nu = aR/(A - 2aR)$ and $\mu = ag/(A - 2aR)$, both being positive

This on solution gives,

$$\sin^{-1}\sqrt{\frac{\mu}{c}}\; e^{\sqrt{\nu}\theta} = \pm\sqrt{\mu}\,t + \phi$$

where ϕ and c are constants

Putting the general solution explicitly in terms of θ we have therefore,

$$e^{\sqrt{\nu}\theta} = \sqrt{\frac{c}{\mu}}\,[\sin(\sqrt{\mu}t + \phi) + \sin(-\sqrt{\mu}t + \phi)]$$

i e, $e^{\sqrt{\nu}\theta} = D\cos\sqrt{\mu}t$ (12)

where D stands for $2\sqrt{\frac{c}{\mu}}\sin\phi$

From the above equation we note that the function $e^{\sqrt{\nu}\theta}$ is periodic and it has the same period as given by equation (10) in the previous case A justifiable linear solution from the logarithmic one i e (12) can be obtained in the case of the lens under consideration for which ν will be generally of the order of one In view of the vanishing magnitude of θ for small oscillations the product $\sqrt{\nu}\,\theta$ will be much less than one and therefore,

$$e^{\sqrt{\nu}\theta} = 1 + \sqrt{\nu}\theta \qquad (13)$$

with sufficient degree of accuracy From (12) and (13) we have

$$\theta = \frac{D}{\sqrt{\nu}}\cos\sqrt{\mu}t - \frac{1}{\sqrt{\nu}} \qquad (14)$$

which again shows the motion to be simple harmonic with the same period as given by equation (10)

V L TALEKAR

Department of Physics,
Dungar College
Bikanor 1 6 1949

---

[1] Talekar V L Sci and Cult 13 118, 1947

THE CHROMOSOME NUMBER AND THE DEVELOPMENT OF THE EMBRYO-SAC IN *CROTALARIA INTERMEDIA* KOTSCHY

The archesporium is hypodermal in origin and differentiates in the second layer of the nucellar tissue as a polygonal cell of large dimensions with thicker and denser cytoplasm and relatively large nucleus and is not always strictly confined to a single cell Oftentimes, two to four such archesporial cells, lying side by side, have been observed, though Samal[2] observes in *Crotalaria juncea* a single archesporial cell differentiating in the third layer of the nucellus, which directly functions as a M M C or cuts off a parietal cell before doing so In this Tropical African species it has been observed that no parietal cell is cut off and the archesporium acts and functions directly as the megaspore mother cell, The M M C undergoes a period of rest during which it is pushed inwards by periclinal divisions of the outer nucellar tissues As a result it is observed in the 4th or 5th layer of the nucellus during the heterotypic division In its resting stage the nucleus contains one conspicuous nucleolus embedded in the chromatin network The general cytoplasm is much vacuolated containing 3 or 4 bigger vacuoles in addition to numerous smaller ones On completing the reduction division a cell plate is formed near about the central region of the cell Oftentimes the lower dyad is a little bigger The second divisions do not follow generally simultaneously in both the cells the upper earlier than the lower resulting in the formation of a tetrad of megaspores The homotypic spindles do not lie parallel to the long axis of the ovule nor at right angles to each other After completion of the divisions and the proper development and growth of the respective spores an oblique T —shaped tetrad is organised as in *C juncea*[2] The four megaspores thus formed differ in size and shape The middle pair are the smallest the uppermost intermediate and the lowest (the chalazal) the largest of all Later on the upper three megaspores show various types of contraction leading to the ultimate degeneration while the chalazal one alone develops and functions These three upper cells after complete degeneration and disintegration are observed as dark staining shapeless masses covering and capping the functional one

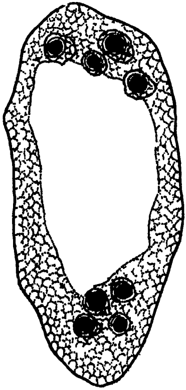


Fig 1

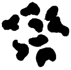


Fig 2

Fig 1 Eight nucleate stage of the embryo sac ×900
Fig 2 Haploid chromosome number from the p m cell ×2400

The active megaspore gradually enlarges and elongates considerably in size It is somewhat pointed at the basal end and broad at the apex Its nucleus does not divide until the cell increases 2 3 times in volume and crushes the adjacent nucellar tissues which ultimately degenerate The cell is much vacuolated and its nucleus is observed in the centre Afterwards the nucleus of the fully developed enlarged megaspore divides into two daughter nuclei near about the centre These two daughter nuclei move and migrate towards the opposite poles being inter connected by the surrounding cytoplasm (*i e* strands) and the *2* nucleate sac is filled with numerous vacuoles some big and many small These two nuclei again divide to form the 4 nucleate stage where the central vacuole becomes very much prominent These four nuclei again divide simultaneously to reach the eight nucleate stage of the embryo sac (Fig 1) the quartet being observed at each pole with a central vacuole much bigger The micropylar end enlarges greatly and becomes broader

There is only one row of ovules on the marginal placenta of the superior monocarpellary ovary and their numbers vary from 11 to 14 though Oliver[1] says it to be 20 30 seeded from his materials collected in Tropical Africa The ovule is anatropous and bitegmic as in *Crotalaria juncea*[2]

The haploid chromosome number as observed in the P M cells is 8 (Fig *2*)

The development of the female gametophyte is of monosporic eight nucleate (Normal) type as observed by Samal[2] Fuller details of the cytology of the plant will be published elsewhere

The writers take the opportunity of sincerely thanking Dr S K Mukherjee Curator of the Herbarium Royal Botanic Garden Sibpur Calcutta for supplying them with the information regarding the systematics of the plant

A K PAUL
R M DATTA

Jute Agricultural Research Institute
Raikes House
Hooghly 1 9 1949

[1] Oliver F *Flora of Tropical Africa* *2* 37 1871
[2] Samal K K The development of the embryo sac and embryo in *Crotalaria juncea* L *Jr Ind Bot Soc* *15* 19 31 1936

A NOTE ON THE BIONOMICS OF *LEPIDOCEPHALUS THERMALIS* (CUV AND VAL)*

This small loach occurs in all freshwaters of the Madras province It prefers to remain partly or fully buried in loose silt and fine vegetable sediments of gently flowing waters which are alkaline with *p*H as high as 8 45 It grows to a maximum size of 70 mm

---

*Read before the Zoology & Entomology section of the 36th session of the Indian Science Congress 1949 and communicated with the kind permission of the Director of Industries and Commerce Madras

The fish feeds mostly on blue green and green algae and on diatoms The following is the full composition in percentage of volume of the food of 250 specimens examined

MYXOPHYCEAE (30%)—*Merismopedia Nostoc Oscillatoria Spirulina*
CHLOROPHYCEAE (40%) *Chaetophora Cladophora Closterium Cosmarium Desmidium Microspora Oedogonium Spirogyra Ulothrix*
BACILLARIEAE (20%) *Achnanthes Amphora, Cyclotella Cymbella Diatoma Fragillaria Gyrosigma Navicula Nitzschia Pinnularia Stauroneis Surirella Synedra Tabellaria*
PROTOZOA (1%) *Carchesium Vorticella*
CRUSTACEA (2%) *Alonella Diaptomus Cypridopsis*
ROTIFERA (%) *Hydatina Pterodina*
MISCELLANEOUS ITEMS (5%) sand grains and debris

The fish attains maturity when 50 mm in size Both ovaries are equally developed and each contains 100 to 150 eggs 0 7 to 0 8 mm in diameter but Day[1] has recorded 2500 eggs in a female specimen. The inner pectoral ray of the male is developed as a flat spine but the reason for this sexual difference is not known The breeding season coincides with the monsoon period as previously observed by Raj[2] During this season the fish swarms in large numbers in shallow areas covered with *Spirogyra* The following are the physico chemical conditions (kindly furnished by Sri S V Ganapati Fisheries Hydrologist) of the Cooum river at Chetpat on September 12 1949 when spawning was observed in the river Temperature—29 4°C turbidity—11 4 cm *p*H—7 9 free CO_2—0 23 p p100 000 bicarbonates—17 54 p p 100 000 chlorides —190 0 p p 100 000 dissolved oxygen—0 99 mg per litre and percentage of saturation—12 Spawning generally occurs during the early hours of the day The fertilised eggs are spherical 0 9 to 1 1 mm in diameter and pinkish in colour and remain attached to the algae The perivitelline space is about 0 2 to 0 3 mm in width The yolk mass is finely granulated and free of oil globules

The embryo with eyes auditory vesicles and somites appear at the end of the first day after fertilisation On the second day stellate brownish pigments appear on the body of the embryo which begins to wriggle about within the egg shell On the third day hatching takes place The hatchling measures about 3 mm in length and is golden yellow in colour Dorsal caudal and anal fin folds are continuous The pectoral fin buds are also developed The larva remains attached to algae showing occasional wriggling movements Mouth and gill openings are formed on the third day Pectoral fins get well developed on the fourth day, and the larva exhibits free swimming activities and also begins to browse on algal filaments Four external gill filaments as described by Bhimachar and David[3], are discernible at this stage The fin fold gets demarcated into dorsal caudal and ventral fins on the fifteenth day Further development is rapid and the adult features are attained within another fifteen days

The villagers in the Chinglepet and South Arcot districts take advantage of the swarming habit of the fish during its breeding season and collect them in baskets for consumption Deraniyagala[4] believed the species to have a partiality for mosquito larvae but Prashad and Hora[5] have doubted its utility as a larvicide Both under laboratory and field conditions I have not observed the fish feeding on mosquito larvae

P I CHACKO

Freshwater Biological Station
Kilpauk Madras 28 9 1949

---

[1] Day F The Fishes of India London 1 1878
[2] Raj B S Rec Indian Mus 12 249 1916
[3] Bhimachar B S and David A Curr Sci 14 74 1945
[4] Deraniyagala P E P Ceylon J Sci 16 1 1930
[5] Prashad B and Hora S L Rec Mal Sur India 6 631 1936

A CHAMBER FOR PHYTOHORMONE RESEARCHES IN THE TROPICS

In order to explain the vernalization and photoperiodic response in rice varieties noted previously[3] it was felt desirable to determine the hormone content of the grains seedlings and the growing apices of the plant Hormonal study of plant needs expensive arrangements for maintaining a temperature of 25°C 88 to 90 percent humidity and darkness in the test room where all operations for avena test could be performed without external disturbances In America and Europe studies on plant hormones have been carried

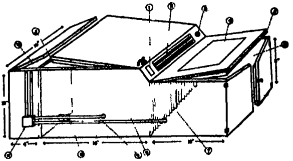


Fig 1

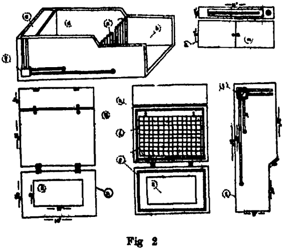


Fig 2

out in specially constructed rooms controlled for temperature humidity and light It has however been previously noted by Avery Creighton and Hock[1] that there is a great difficulty of controlling temperature humidity and carbon dioxide content when several persons are to work in this expensive room Accordingly they designed a low cost chamber for phyto hormone test This chamber suitable for temperate regions has limited applications in the tropics specially in Calcutta during hot rice growing season because of higher temperature and marked variations in humidity In view of the climatic changes the following test chamber has been devised to initiate researches on growth hormone of rice and other tropical plants This has certain advantages over that of Avery Creighton and Hock

The test chamber (Figs 1 and 2) is made up of wood of ½" thickness outside is brightly polished and inside coated with a thin layer of paraffin It is divided into three compartments the foremost one is operating compartment (6 b) the middle one is humid (8 d) and at the rear there is a small light compartment (12 e) The operating compartment has opening doors with a revolving knob (m) for closing and one upper lid (5) The upper lid is provided with a dark ruby glass (4 k) which is needed for the illumination of the operating compartment without inducing phototropic curvatures In this compartment soaked *Avena* grains are kept in petridishes for some hours during sprouting as illumination with red light checks the growth of the first internode This compartment is also used for the manipulation of the test plants *e g* decapitation blocking and shadowgraphy A piece of blotting paper moistened with water is placed on the floor of the operating compartment during decapitation and blocking of the test plants In the humid compartment test plants are cultured in darkness Under the lid of this compartment a wire gauze jacket is fitted (*i*) inside of which a cotton pad is placed The moist pad maintains 88 to 90 percent humidity inside the chamber Control of humidity is one of the most difficult task in tropical countries After a number of experiments it was found that thoroughly moist cotton pad filling inside a wire guaze jacket is just convenient for the purpose This compartment is provided with a mercury thermometer (2) and ventilation arrangement In order to maintain the percentage composition of air normal an arrangement has been made for the circulation of air between the chamber and the outer atmosphere This consists of two glass tubes (9) and a small electric heater (11 f) The function of the heater is to raise the air temperature to a very small degree 30° to 35°C the hot air thus becomes rarified and escapes the empty space is then filled with humid air of the chamber the fresh air from the outer atmosphere gets into the chamber through the other air leakage to maintain the atmospheric pressure constant The ventilation arrangement prevents the chamber from being saturated with moisture and the water vapour constantly rising from the zinc tray prevents the humidity from falling off One great advantage of this chamber is that one can work with this in the laboratory room of the tropics without air conditioning From October to March the variation of temperature recorded inside the chamber was 25°±2°C This small variation is obviously due to the materials used for the construction of the chamber high percentage of humidity and the ventilation arrangement provided for The chamber can also be placed inside a Frigidaire case controlled at 25°C

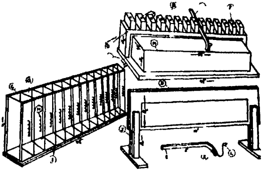


Fig 3

For the culture of *Avena* coleoptiles a special test set (Fig 3) has been used This consists of glass holders of size 3"(F) a wooden rack of 9½"×2¾"×1½" (P) a zinc tray of 8½"×1½"×1¼" (M) a glass box of 8¼"×1¼"×3" (I) The *Avena* coleoptile wrapped with cotton wool was held in position by means of the ring (I) of the glass holder by adjusting the handle of the glass holder the coleoptile could be placed at any desired position On the upper board (O) of the wooden rack a row of 14 cork pieces of sizes ½"×½"×¼"(B) are fixed leaving small spaces in between which the glass holders are placed securely The roots of the test plants are kept immersed in water in the zinc tray placed on the lower board of the wooden rack The glass box is placed on the tray and divided into 13 compartments by glass partitions ( ) one for each test plant The glass partition wall is provided with a centimeter scale (H) *for selecting the test plants having equal length* With this arrangement uniform curvatures of avena test were obtained

At the rear of the chamber there is a small light compartment (12 e) containing an electric lamp connected with a variable resistance (3) and an exposure switch The lamp is used for taking shadowgraph Light is focussed through a biconvex lens of radius 4 cm and thickness ⅝ cm fitted in an adjustable frame (10) Each door and lid is lined carefully with extra linear so that no light gets into the chamber In order to obtain accurate and sharp shadowgraphs of the curvatures a special arrangement inside the chamber is made and on no account test plants are to be transferred to a different atmosphere This is an additional advantage of this chamber Photographic paper (Velox D W S G 2s normal) cut into convenient sizes are placed inside a shadow frame (D) consisting of two pieces of extra thin glass plates of 10"×2¼" and thickness 1 2 mm on an adjustable aluminium frame The shadow frame fixing the paper on a single plane prevented it from its possible bending and curving and at the same time the wetting of the paper with agar blocks is avoided as the test plants are to be placed as close as possible to the shadow frame Light intensity can be changed with the help of a variable resistance which is found to be necessary for taking good shadowgraphs Generally an exposure of 4 seconds from a 100 watt lamp with full intensity produces a good shadow graph

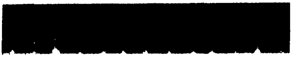


Fig 4

The shadowgraph (Fig 4) records the *Avena* curvatures produced in this chamber by the application of growth hormones in alkali extraction from the endosperm of rice The curvatures show the hormone content to be 0 50 million T D C per gm of dry endosperm tissue a value much higher than that recorded by Avery, Berger and Shalucha[2]

We desire to thank Dr K Kar Professor of Physics, Presidency College Calcutta for his suggestion in the electrical arrangement for air circulation and to Sree M L Banerjee for technical help in the construction of this chamber This work was done at the Department of Botany University College of Science and Technology Calcutta while the senior author held a lecturership in Botany

Central College of Agriculture S M SIRCAR
Anandaparbat, New Delhi

Department of Botany T M DAS
University College of Science and Technology,
Calcutta, 12 10 1949

[1] Avery G S Jr Creighton H B and Hock C *Amer Jour Bot* 26 2 360 365 1939
[2] Avery G S Jr Berger J and Shalucha B *Amer Jour Bot* 28 596 607 1941
[3] Sircar S M *Lotsya 1 Chronica Botanica* 121 128 1948

RICKETTSIOSIS IN INDIAN SHEEP

The object of this note is to record for the first time in India the occurrence of rickettsia in Indian sheep At the end of June 1949 three sheep under sheep pox experiment showing a secondary rise of body temperature revealed the presence of rickettsial bodies within the monocytes of their peripheral blood smears Morphologically and in their tinctorial character those bodies closely resembled *Rickettsia ovina* as described by Lestoquard and Donatien[1] in the blood from diseased sheep in Turkey and Algeria According to these authors *R ovina* occurred as minute coccoid granules, one to thirty in number, grouped in masses 2 to 8 microns in size With Giemsa they stained uniformly dark red while with Castaneda technique they did not stain at all The organism encountered in the Indian domestic sheep occurred also as comma-shaped or rod shaped bodies besides coccoid forms and their number within one cell varied from one to twenty (Figs 1 & 2, a, b, c, d) Schulz[2] has recorded a

Fig 1

Photomicrograph of a field showing *Rickettsia ovina* in the cytoplasm of a monocyte X 725 Giemsa's stain

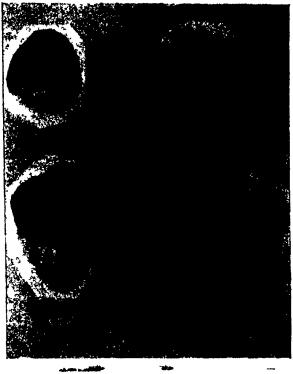


Fig 2

Fig 2 Camera lucida drawings of monocytes showing *R.ovina* in their cytoplasm Giemsa's stain

a Monocyte showing a single rod shaped body
b " " 8 comma-or rod-shaped body.
c " " four groups of coccoid bodies
d " " five groups of coccoid bodies of varying sizes and one comma shaped body

few fatal cases due to *R ovina* infection in sheep in S West Africa

With a view to ascertain if this rickettsia was responsible for producing any disease two sheep that were discontinued from sheep pox experiment were given the infected inculum (10 cc each) It is now over two months and both these experimentals have shown a febrile reaction of intermittent type The peripheral blood of one to which the infected blood was given intraveneously started showing *R ovina* from the third day and died on the ninetyfourth day after inoculation while the other which received the inoculum subcutaneously commenced showing the organism from the fourteenth day and is still alive The one which died showed pneumonic lesions in the anterior lobe of both the lungs The lung smears however showed *R ovina* in the monocytes Two naturally infected cases are also kept under observation and they are also showing intermittent type of febrile reaction for the last one month and a half Several other sheep from the healthy stock have also been observed to harbour this rickettsia In few instances the tick *Hæmaphysalis bispinosa* has been recovered from the body of some of these infected sheep but the role played by this tick in the transmission of rickettsia from sheep to sheep yet remains to be established However from these few remarks of exploratory nature it is obvious that investigations on the incidence of rickettsiosis in domestic sheep deserves the attention of the field workers in India

It may be added here that the disease conditions affecting sheep and goats in India have not received the due attention and therefore the aetiology of such conditions have remained obscure However with the establishment of sheep or goat breeding farms throughout the country it is emphasized that every attempt should be made to investigate the aetiology of these obscure diseases so that proper eradicative or control measures could be evolved

I am indebted to Dr S Datta Director Indian Veterinary Research Institute for kindly permitting me to publish this note The help rendered by Shri R B Seth and Shri H S Dhillon in carrying out these observations is gratefully acknowledged My thanks are also due to Babu Shankaranand for helping me to take the photomicrograph illustrating this note

H N Ray

Section of Parasitology
Indian Veterinary Research Institute,
Mukteswar Kumaun U P
27 10 1949

---

[1] Lestoquard F & Donatien A *Bull Soc Path Exotique* 29 105 108 1936

[2] Schulz K *Onderstepoort J Vet. Sci Anim Indust* 13, 287 289 1939 (Also *J S Afric Vet Med Assoc*, 10, 176 178 1939)

THE ROLE OF DARK COLOURED FUNGI IN THE MICRO BIOLOGICAL DETERIORATION OF SUN EXPOSED JUTE FABRIC

During the course of several years we have made microbiological analysis of many samples of fabrics (jute) and tentages (jute and cotton) which had been damaged due to outdoor exposure to sun and rain While a part from the damage was undoubtedly caused by the ultraviolet rays in sunlight there was unmistakable evidence of active fungal growth on many samples Almost invariably dark coloured fungi belonging to the Dematiaceae family of the *Fungi Imperfecti* were isolated from the samples However in another set of controlled experiment in which jute fibres and yarns were incubated in the laboratory at relative humidities ranging from 75 100% members of the Dematiaceae family were conspicuously absent even after prolonged incubation Other observers have noted the preponderance of dark coloured or thick walled fungi on sun exposed cotton fabrics and it has been suggested that this might be due to the comparative immunity of such fungi by virtue of their dark pigments to the u v rays of sunlight An able summary and discussion of this interesting subject appears in a recent paper by Marsh and Bollenbacher [1]

We have done some experiments in order to test the validity of this hypothesis and the results obtained seem to explain the apparent anomaly in our previous findings as reported above Of two identical portions from a sample of jute hessian one was incubated over water in a desiccator placed in the laboratory in semi darkness the other mounted on a frame was exposed on the roof facing the sun s meridian The experiment lasted from August 9 to October 17 during which period there were frequent rains with intermediate spells of sunshine the day time shade temperature remained between 34° 28°C At the end of the period the out door sample showed dark patches whereas the sample in the desiccator though covered with mildew growth was free from any dark stains Two small pieces of identical size were cut out from each sample and each piece plated out separately on a suitable medium The extent of growth of the various fungi as judged by the number of colonies are set out in the table below Organisms giving less than 20 colonies on both plates taken together are ignored In a similar plating out of the original fresh fabric altogether eight species (of *Aspergillus Penicillium and Pæcilomyces*) made their appearence all but *Aspergillus niger* giving slight growth only

TABLE SHOWING GROWTH OF FUNGI ON JUTE HESSIAN ROTTING IN SHADE AND EXPOSED TO SUN

	Indoor sample	Outdoor sample
Aspergillus niger	heavy	slight
Aspergillus terreus	moderate	absent
Paecilomyces varioti	heavy	absent
Penicillium luteum (ascogenous)	heavy	absent
Curvularia lunata	absent	heavy
Alternaria sp.	absent	heavy

It is seen from the results that growth inside the desiccator was confined to species having hyaline hyphæ

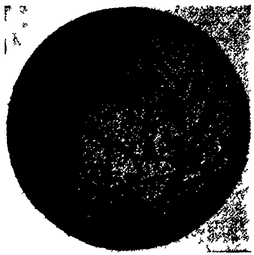


Fig 1 Hyphae and spores of *Curvularia lunata* x 220

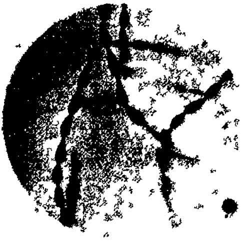


Fig 2 Spore chains of the *Alternaria* sp x 220

these species have been isolated on numerous occasions from jute materials similarly rotted On the other hand on the outdoor sample only *Curvularia lunata* and *Alternaria* sp show heavy growth

It would thus appear that normally the Dematiaceae are suppressed by the competitive growth of other fungi Previous results obtained by one of us[2] have also shown that when two species are allowed to grow together on a cellulose medium one may be suppressed by the other although in pure culture the former may be a stronger cellulose decomposer than the latter In presence of sunlight fungi with light coloured or hyaline hyphæ are killed off or inhibited but fungi with dark hyphæ survive the pigment in them acting as a barrier against the u v rays Even *Aspergillus niger* which has thickly pigmented black spores did not thrive

It should be noted that growth outdoors was considerably less than in the desiccator which is to be expected because not only was there less regular moisture supply and the flora restricted but the Dematiaceæ prefer rather low temperatures for optimum growth It is also to be noted that the two Dematial species obtained were the two most frequently encountered in our previous experience with sun exposed fabrics *Curvularia lunata* has always been somewhat more predominant than the *Alternaria* sp

These results emphasise the extreme importance of competition in the natural growth of fungi and the very limited importance of results obtained from pure culture tests alone—considerations which are often overlooked Their implications on the rot proofing of textiles of diverse uses and also on the testing of such treated fabrics for rot resistance are obvious

S N Basu
S N Ghose

Microbiological Laboratory
Indian Jute Mills Association Research Institute
Calcutta 1 12 1949

---

[1] Marsh P B and Bollenbacher K *Text Res J 19* 313 34 1949

[2] Basu S N *J Text Inst 39* T237 T248 1948

BOOK REVIEWS

Economic Geography of West Bengal—By P C Chakravorty M Sc Commerce Dept City College Calcutta Price Rs 2 8 0

Factual information on Climate Agriculture Industries Trade and Transport is culled from different sources and assembled in the present book on West Bengal by Mr P C Chakravorty The eight well drawn maps included in the book definitely to portray the geo economy of West Bengal do not fully serve the purpose as they (maps) are much generalised and some of them out of date The cartographic methods employed are also defective The true distributional patterns of the different components of the geo economy of the province are not revealed by these maps With regret we record that accompanying notes contain some technical blemishes

To a non geographer the book may serve some useful purpose informing general idea of the Economic Geography of the new Province of West Bengal but a serious student of geography would be disappoin ted as the author in his hurry to meet the pressing demand of the B Com examinees has to some extent sacrificed the scientific discipline of this young and developing Socio Economic science *Some Maps of West Bengal at a cursory glance* would have been a more appropriate title for the book than the present one

An Introductory Course in College Physics —By Newton Henry Black Third Edition Pages xiv +800 New York The Macmillan & Company Ltd 1948

This is a text book on physics for beginners To introduce a science subject like physics to beginners with no previous initiation in it is no easy job Careful sifting of material clear exposition of the principles involved in different physical phenomena dealt with and unambiguous definitions—these above all go to make a book really suitable for beginners In the book under review the author has made a happy blending of these qualities to produce a volume which amply justifies its title The author has an inimitable style of lightening the purely technical atmosphere of the subject so pressing to beginners

The book comprises 5 parts Mechanics Heat Magnetism and Electricity Sound and Optics

In the first part elementary principles of statics and dynamics are described Chapters on Rotatory Motion and Fluid in Motion give some additional information in comparison with most other books of the same standard

Chapters 13 17 constitute the Heat section A separate well written chapter has been devoted to the Physics of the Atmosphere Chapter 17 gives a detailed account of the various kinds of Heat Engines and their performance

Next comes Magnetism and Electricity covering chapters 18 28 Besides describing the basic principles of this most useful branch of physics the author has given a more or less complete account of the engineering aspect of the subject A separate chapter has been allotted to Radio

In barely a score of pages the elementary principles of Acoustics has been very lucidly described

Chapters 31 36 make up the Optics section In chapter 34 on Spectra and Colour a very interesting account is given on Coloured pictures and Colour printing In chapters on Diffraction and Interference and Polarisation elements of wave optics have been introduced

The concluding chapter of the book is on Radio activity, Structure of Matter In this chapter is given a short account of the activities in the field of Modern Physics, Wilson Cloud Chamber, Geiger counter Cosmic rays Mass Spectrometer Isotopes Mass and Energy, Artificial Radioactivity—Cyclotron and Betatron—Fission of the Uranium atom—Chain reactions—Nuclear energy—these topics have been briefly but intelligibly described

Addition of Problems and a Summary at the end of each chapter has increased the usefulness of the book Photographs of important scientific personalities with historical notes is an additional charm Insertion of Maxwell and Einstein s photographs would be desirable

The book is remarkably free from printing mistakes The only printing mistake the reviewer has come across occurs on page 675 section 666 5th line — aperature for aperture Paper printing and diagrams are excellent There is a useful Appendix to the book

Intermediate Science students of Indian Universities will find a real help mate in the volume

R D

The Presentation of Technical Information—By Reginald O Kapp B Sc (Eng) M I E E Constable & Co Ltd 10 Orange Street London W C 2 Crown 8 vo pp vii + 147 1948 (8 Sh net)

Scholarship would be sterile if its achievements were not disseminated The dissemination of technical information whether it is in the form of books papers articles or reports forms today one of the most important spring boards of scientific advancement Although volumes have been written on the art of literary presentation no serious attempt was made upto a very recent date to outline the fundaments of technical presentation It is therefore quite encouraging to see the publication of two small books one under review and the other by G E Williams (Technical Literature Its Preparation & Presentation 1948 Unwin) both of which come from the pen of electrical engineers

The text under review is based on four public lectures given at the University College London in the summer of 1947 by Reginald Kapp Pender Professor of Electrical Engineering and Dean of the Faculty of Engineering University of London This work differs from some of the previous publications (W Paul Jones Writing Scientific Papers & Reports Iowa 1946 J R Nelson Writing the Technical Report McGraw Hill 1947) in that attention is focussed on the functional aspect of the language as opposed to its imaginative counterpart The psychology underlying the art of technical presentation is expounded by the author in a stimulating and lucid manner In fact the author s presentation is in itself a model of what he is writing

There are in all fifteen chapters and a good index Typical of these are Functional English Choice of Material Making It Easy to Understand Circumlocutions Metaphor & Words The last chapter on Words, discusses the proper use of technical terms, and gives actual examples of the correct and incorrect phraseology

The author clearly brings to light the important but neglected fact that knowledge of the subject is by no means all that is essential for good technical writing The art of translating his ideas into clear and lucid sentences capable of being understood by the person addressed is more essential than the lumping together of mere scientific facts As admirably put forth by Professor Kapp the problems arising in scientific writing are most often problems in logic and psychology Teach a man to think clearly writes the author and he is likely to express himself clearly teach him to think about the person addressed and he will have learnt the first lesson in the art of conveying information effectively from mind to mind But teach him only how to turn out well constructed sentences and he may fail badly in the art of exposition In these days of scientific and techonological progress as a large percentage of printed matter is usually made up of technical literature the art of good scientific presentation has to be learnt by many In fact the importance of this aspect can be gauged from the fact that the University College London has added the subject of The Presentation of Technical Information to its engineering syllabus Scientific writing is one of the best means of developing one s inherent creative ability and adding to his store of knowledge It provides training in clear thinking intellectual grasp and insight orderly construction and succint expression as beautifully exemplified by the author of this text This work can be confidently recommended to all those who are eager to study the art of technical exposition

S K G

Principles of Organic Chemistry—by J English Jr Ph D and H G Cassidy Ph D Associate Professors of Chemistry Yale University Mc Graw Hill Book Company Inc New York Pp 512 $ 5 0

The book appears to be an introductory text book of organic chemistry and is quite suitable for under graduate students who intends to specialise in organic chemistry in near future It excludes the chemistry of heterocylic compounds but deals with both aliphatic and aromatic compounds comparatively For instance aliphatic alicyclic and aromatic hydrocarbons have been discussed in neighbouring chapters amines and diazonium compounds in the same chapter alcohols and phenols in a comparative style in the same chapter and so on The problems requiring a fair knowledge of the reactions of organic compounds are included at the end of each chapter and the bibliography to help further reading after every chapter is well selected The electronic interpretation of organic reactions has not been overlooked The book can well be recommended as a basic book for university students with chemistry as the main subject The study course, has to be supplemented by special chapters and topics from higher books of organic chemistry For Indian students the price of this book which is intended for a college text book is rather high and the teacher has to think twice before recommending this well graduated book to his students

R C

Proceedings of the National Conference on Industrial Hydraulics Vol I Conference Secretary Armour Research Foundation Technology Centre Chicago 16 Illinois U S A Paper cover 6" × 9" pp viii+129 with photographs 1948 $ 3 00

In 1945 the first Conference on Hydraulic Machinery was inaugurated by Armour Research Foundation of Illinois Institute of Technology U S A The present publication contains papers presented at the third annual meeting held in Chicago on Oct 16 17 1947 There are in all ten papers and covers hydraulic controls cavitation automotive transmission and industrial applications

The subject of hydraulics is as old as the universe Its primitive applications date back to some three centuries when that renowned French Scientist Blaise Pascal first discovered in 1658 the law regarding fluid transmission and thereby brought the abstract physical science into the realms of engineering Today hydraulically controlled equipment is used for operating a number of diverse machines in engineering such as airplanes ships automobiles metal working processes textile and construction industry In fact it fully competes with another universal source of operative power—electricity The papers contained in the present book mainly cover the application of hydraulics and balances the work of educational and research institutions on the one hand with the technical requirements of industry on the other

The field of hydraulic controls covers the fundamentals of governor operation for prime movers and hydraulic circuits of industrial process controls The latter phase is covered in an elementary fashion and does not fully deal with hydraulic servomechanism (*Vide* Hunsaker & Rightmire Engineering Applications of Fluid Mechanics McGraw Hill N Y 1947) The three papers on cavitation give much food for thought The paper by Prof Hunter Rouse deals with basic characteristics of cavitation and the means of eliminating it His outstanding work in hydraulic research enables him to give a masterly survey of the phenomena which is now attracting the earnest attention of engineers in diverse branches The two other papers deal respectively with cavitation in marine propulsion by K E Schoenherr of the Univ of Notre Dame and cavitation in centrifugal pumps by R M Watson. Automotive transmissions is covered by two papers one dealing with the developments in the field and the other with hydraulic coupling design. The application of industrial hydraulics is dealt with in three papers on variable speed hydraulic power transmission hydraulic seals and applications of hydraulic fluids

As a conference sponsored with the co operation of the leading American engineering societies it fully lives up to its status evidenced by the publication of these papers which form a useful and authoritative compendium on industrial hydraulics

S A C

Electrons in Gases—By Sir John Townsend F R S Hutchinson s Scientific and Technical Publication London 1947 Pp VIII+166 Price 25s net

Sir John Townsend is a pioneer and leading authority in the branch of physics described in the book under review In this monograph he explains how the effects of collisions of electrons with molecules have been deduced from experiments with small currents in uniform fields of force through gases at various pressures The book comprises 5 chapters In the first chapter the theory of the motion of electrons and ions in gases has been developed in its logical sequence Distribution of velocities of agitation free paths equation of continuity etc are explained fully and very neat mathematical derivations are given thereof

Chapter 2 is experimental and describes the determination of the energy of agitation and mobility of electrons in gases One cannot but be struck by the extreme simplicity of the experimental arrangements and the variety of data derived with their help Experimental results on the mobilities and energies of agitation in different gases are given in numerous Tables and Graphs

Chapter 3 deals with the Mean Free Path and Energy loss of electrons in Elastic collisions Some of the experimental data on the energy losses of electrons in collisions with monoatomic and diatomic gases are very interesting because they show that there are certain ranges of energies in which the mean free path of an electron increases as the energy diminishes This chapter ends with a few important tables of experimental data

Chapter 4 gives a brief survey of the causes of inequalities in the velocities of electrons and the phenomena associated with these inequalities

In chapters 5 and 6 the author describes the phenomenon of ionization of molecules by collisions of electrons and positive ions The most important result deduced from the experiments is that when the molecules of a gas or vapour are ionised by the collisions of electrons or positive ions, the negatively charged particles which are set free from the molecules are themselves electrons, since they ionise other molecules at the same rate as the electrons set free from an electrode by the action of ultraviolet light Radiative activation of molecules by electronic collisions and the properties of the active molecules are described at some length The effects of impurities on the ionization of mono and diatomic gases are properly stressed

Chapter 7 gives a theory of the actions of positive ions in discharges which is in accordance with the properties of discharges in uniform fields of force and of discharges between coaxial cylindrical electrodes

A few errors of omission and commission have crept in the book page 8 3rd line dq^2 for dy^2 page 29, 10th line $(n_1+n_1+n_3)$ for $(n_1+n_2+n_3)$ page 29 12th line nummer for number page 71 13th line duplication of the page 87 12th line $\cos\theta_3$ for $\cos\theta_2$ page 92 33rd line changed for charged page 149 23rd line there should be an in between given and terms page 149 26th line degress for degree

Addition of an index would have enhanced the value the book The monograph deserves a prominent place on the shelf of any advanced student or research worker in the field of atomic physics

R D

A Hand Book of Precious Stones—By Dr L A N Iyer Published at the Baptist Mission Press Calcutta Price Rs 15 net

The book contains valuable information regarding the origin properties and uses of precious and semi precious stones First few chapters deal with the crystal forms mineralogy and other important properties of the common gem stones and the other characteristics by which one can understand that it is not a common mineral but it is something extraordinary Being a veteran teacher of the science of mineralogy Prof Iyer has a special power of explaining the different peculiarities of these rare minerals in a very simple manner The book is written in a popular way and the complicated behaviour of the gem minerals by which laymen get attracted to the outward charm of a cut stone has been elucidated very clearly so that the dealers of precious stones might be able to convince their customers as to the genuineness of the material they are selling

The process of gem cutting is also carefully explained and the description of our famous Indian rare stones are also included The book will be interesting to the people of this country as well as others who are interested to know about the Indian gem stones X ray study of precious stones which is the latest development in the field of study of the minerals of this nature is very meagrely treated in this book moreover the book contains very few figures and photographs which are usually found in German and American books concerning this subject The price also seems to be bit high

Prof Iyer s book will be very much useful to the graduate and post graduate students interested in doing research work in the mineralogy of the gem stones and also the dealers of gems will be profitted by it Every reference library should possess a copy of this book

S. D.

An Elementary Text Book of Organic Chemistry—By D D Karve, M Sc, A I I Sc, Ph D, Professor of Chemistry, Fergusson College, Poona Dastane Brothers' Home Services Limited Pp 192 Price 2 12 0

The book as the name implies is written for the I Sc students of several Indian Universities and presents the elementary portion of organic chemistry The book is written rather in an orthodox way laying special stress upon the outline of preparation and properties of common organic compounds The preparative side of organic chemistry and correlation of the reaction of organic compounds have unfortunately been not developed in the chapters of the book Even then for an elementary knowledge of organic chemistry, it will be of help to the students for whom it is intended

R C

Qualitative and Volumetric Analysis—By J C Giblin, B Sc, A R I C, Longmans, Green and Co, pp 172 Price not mentioned

This book provides a complete course in Qualitative and Volumetric Analysis upto B Sc Pass Standard of Indian Universities In this book are included many organic reagents which exhibit a specific or selective action with metallic ions, and at the same time older tests are not dispensed with

The book is divided into four parts, (1) qualitative analysis of simple salts and mixtures, (2) qualitative analysis of more difficult mixtures, including two or more metals in the same group, (3) organic reagents for metals and acid radicles, and (4) volumetric analysis An explanation of the methods of separation used in different groups, based on the concept of solubility product is a good feature of this book

The author has not overlooked the fact that the teaching of the classical methods of analysis provides not only well standardised methods but also a method of training in logical thinking He has eliminated many of the methods of reaction and has mentioned only those really responding tests, which he has selected from his own laboratory experience

R C

Selected Topics from Organic Chemistry—By D D Karve, M Sc, A I I Sc, Ph D, and G D Advani, B A, M Sc, A I I Sc Dastane Brothers' Home Services Limited, Poona Pp 418, Price Rs. 10/-

The book deals with essays on specialised topics on organic chemistry, *e g* Vitamins and Hormones, the Reactive Methylene Group, Oxidation in Organic Chemistry, Vegetable Alkaloids etc In India, such selected topics are required for the undergraduates who eventually intend to specialise in organic chemistry, or the post graduate students who are specialising in the subject Unfortunately the chapters fall short of the standard of such specialisation or intended specialisation For instance, the section of catalytic reduction in the chapter on catalysis in organic chemistry, is not representative, and the statements are not supported by apt examples In the chapter on condensation and reaction, the author mentions Pechmann's reaction and other reactions of less importance and overlooks more important ones as Knoevenagel's reaction and Michael's condensation He talks of some useful reagents in organic chemistry and drops the common reagents bromine and red phosphorus for bromination This book appears to be very useful to undergraduate students with organic chemistry as a subsidiary subject

R C

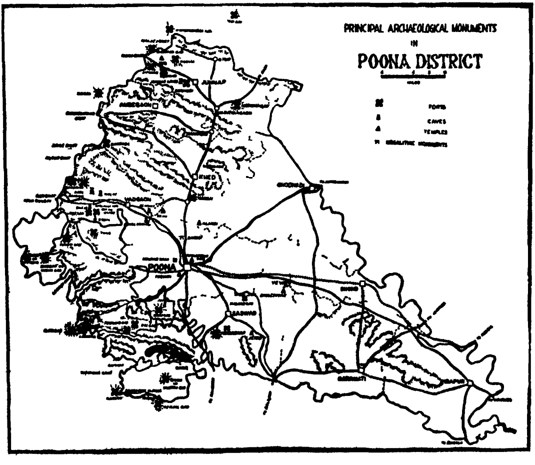
POONA

AN attempt is made in this article to give our readers and those attending the 37th session of the Indian Science Congress at Poona an outline of the history of this historic city and of the unique part played by it in the political social and cultural history of India

POONA DISTRICT

Lying between 17°54 and 19°22 north latitude and 70°24 and 75°14 east longitude the District of Poona has an area of about 5 320 square miles and a population of 13 59 408 or 255 to a square mile according to 1941 census In 1891 these figures were 9 00 621 and 168 respectively Greater Poona has a population of nearly four lakhs and is situated at a height of 1850 ft Two streams, the Mula and the Mutha which rise in the Western Ghats join in the centre of the city and the united stream flow into the Bhima which again flows into the Krishna and ultimately to the Bay of Bengal

In the west along the Sahyadris (Western Ghats) Poona district has a breadth of seventy or eighty miles From this it stretches about 130 miles south east sloping gradually from about 2000 to 1000 feet above the sea and narrowing in an irregular wedge shape to about 20 miles in the east It is bounded by the Ahmednagar District in the north and the east Sholapur on the south east Satara on the south Kolaba and Thana on the west



The hills of the district belong to two distinct systems. One running on the whole north and south forms the main range of Sahyadris about 73 miles in a straight line and about 90 following the course of the hills The other system of hills includes the narrow broken crested ridges and the bluff topped masses that stretch eastwards and gradually sink into the plain The crest of the Sahyadris falls in places to about 2000 feet the level of the western limit of the Deccan plateau In other places it rises in rounded bluff or clear cut ridges 3000 or 4000 feet high

Geology of Regions around Poona Almost all the rocks around Poona are varieties of Deccan Trap basalts consisting mainly of plagioclase (usually labradorite) and enstatite augite and small amounts of titaniferous iron ore and glass As is well known the rocks in the Deccan have resulted by cooling and solidification of extensive lava sheets poured out intermittently through huge volcanic fissures The eruptions took place sometime between the close of cretaceous and early tertiary periods when vast areas in the Indian peninsula were covered by lavas the area covered by these rocks today is not less than 200 000 sq miles

Beds of valcanic ash are common in the District these and several thin beds of red and green earth are distributed here and there between the sheets of basalt At a number of places the traps yield good building stone and road material Some compact dark varieties are capable of taking a high polish and are used for making idols and ornamental purposes

Prehistory Flakes of agate quartz chalcedony etc found on the hills in and around Poona (for instance at the Fergusson College Hill and the Hill at Dighi) have been regarded as representing a microlithic cultural phase by scholars like D M Gordon but it is doubtful if these flakes which resemble microliths are really tools No palaeolithic remains have been genuinely established in this district

Again a few miles from Poona at Bhavsari and at Rajur one notices small megaliths like dolmens menhirs and stone circles While these do resemble in shape though not in size similar monuments in Karnatak and S India it is very doubtful if these monuments are so old or belong to the megalithic period Nevertheless they do seem to hand down the tradition of the connexion of such monuments with the dead

Early Historic Monuments From very early times trade routes must have crossed Poona district down the Sahyadri passes to the Konkan sea ports of Sopara Kalyan and Chaul Rock cut temples rest chambers (*Viharas*) and inscriptions show that as far back as the first centuries before and after Christ trade went to and from the coast by the Nana and Bhor Ghats (passes) The richness of the rock cut temples both above the pass at Bedsa Bhaja and Karla and below the pass at Kondane and Ambivate makes it probable that in the first century after Christ a great traffic moved along the Bhor pass route The (early history) of the Poona district centres in Junnar *lit* old city 56 miles north of Poona Of the Founders Junnar nothing is known This is surrounded by four groups of hills Sivaneri Manmoda, Ganesh which contain 135 early Buddhist caves These are not simple cells, but houses with kitchens study rooms council halls etc On the Nana pass route Junnar is a city strongly placed in a rich country with good climate and facilities for trade Junnar is probably as old as the large inscription on the walls of the rock cut chamber at the head of the Nana pass which originally contained besides the inscription statues of members of the Imperial Satavahana dynasty (100 B C to 200 A D)

The inscription which is in Brahmi script of the second or third century B C records gifts to Brahmins on the completion of some Vedic sacrifice by Queen Naganika mother of Prince Skandasri and probably wife of Emperor Satakarni the third in the Satavahana dynasty

Poona district appears to have gone into obscurity after the fall of the Satavahans (300 A D) and no monuments of the Imperial Chalukyas of Badami (550 750 A D) have been found here The Panchalesvar cave near Poona seems to have been excavated during the Rashtrakuta times (750 972 A D) Earliest reference to Poona Punyavisaya and Punakavisaya the river Mula on which it is situated and the surrounding villages is found in copper plates of A D 759 and 769 respectively No monuments of the Kalyani chalukyas (970 1190 A D) have been found here

During the 12 13th century the region formed part of the Yadava Empire with its capital at Devgiri (Daulatabad) Some of the hill forts with which the district is studded for instance the one at Shivaner where Shivaji was born near Junnar Purandar etc seem to have first come into prominence at this period

There are some scanty remains of Yadava times in the temples of Narayanesvara and Punyesvara and in Shaikh Shallas tombs in the Kasba Peth After the fall of the Yadavas in 1312 the country passed successively under Bahmani Sultans (1345 1512) the Nizamshahi dynasty of Ahmed Nagar (1500 1636) and the Adilshahi dynasty of Bijapur (1688 A D) During these times the hill forts came into prominence

Not less than 15 big hill forts are situated in this district These are primarily fortified hills or hill tops provided with the barest necessities of life like cisterns for storing water or grain and simple plain houses for living and keeping horses etc No place of the type one associates with Mughal forts at Delhi Agra etc is to be found in these Maratha forts

One of the most famous is Sinhagad originally known as Kondana 12 miles south west of Poona famous to students of Indian history as the scene of the brave fight of Shivaji s general Tanaji Malusare against the Mughals It is 4332 feet above sea level and 2300 feet from the surrounding plain

Others are Lohagad about a mile south of Malavali station, 35 miles north of Poona and one of the strongest of the Deccan forts and perhaps fortified since very early times since it has a number of caves, which might be of the Buddhist period

The fort of Shivaner near Junnar, is the birthplace of Shivaji the founder of the Maratha Nation and about 52 miles north from Poona the fort contains early Buddhist caves rock cut steps and fine water cisterns probably of the Yadava period arched gateways prayer hall and mosque and a tomb of early Muslim period and some of the buildings of the Marathas.

The fort of Purandar consisting in reality of two hills is about *22* miles south east from Poona is also famous in Maratha history

Poona has a number of places of pilgrimmage—*Alandi* 12 miles to the north of Poona where lived Jnaneshwara (A D 1275) one of the earliest Marathi commentators on the *Bhagavad Gita* *Dehu* about 30 miles north west of Poona is well known as the birth place of Tukaram a famous poet saint of Maharashtra in the 17th century and a contemporary of Shivaji

The temples at Poona Nageshvara in Somvar Peth which is supposed to be the oldest temple in Poona was probably built in the 15th century The temple of Omkareshvara almost in the river bed was built at the time of Sadashivrao Bhau (1740 60) The temple of Belbag in Budhwar Peth was built by the famous Maratha administrator Nana Phadnis (1770 1795)

The Parvati Hill having the ruins of an unfinished palace was begun by the last Peshwa Bajirao

The Shanwar Wada was a six storied building with several large and small courtyards and was the chief residence of the later Peshwas but was destroyed by fire in 1827

After the obscurity of Mahomedan times (1312 A D to 1627) Poona emerges into prominence with the birth of Shivaji as students of Indian history know Poona was held as a Jahgir by Shahaji Raje Bhosle the father of Shivaji and a general first of the Nizamshahi Sultans of Ahmednagar who transferred his allegiance to the Adilshahi Sultan of Bijapur on the fall of Ahmednagar Shahaji assigned 36 villages to Shivaji when he was 12 years old (A D 1642) Poona then consisted of a few villages now comprising the Kasaba Peth while beyond the walls all was jungle After Shahaji s transfer to the Karnatak Poona was ably managed by his agent Dadaji Kondadeo under whom Shivaji received his education Shivaji s achievements which resulted in the birth of the Maratha Nation commenced when he was in Poona The Quadrilateral of forts constituting of Sinhagad Purandar Rajgad and Torna on which rested the main strength of Shivaji lies in the neighbourhood of Poona Shivaji s palace Lal Mahal lay opposite to the site of Shanwar Wada of the Peshwas Poona appears then to have been a fortified town but the fortifications were dismantled by Murar Jagdeo a minister of Bijapur Every inch of ground in Poona and the neighbourhood reminds one of the great Maratha hero and his exploits

But the real importance of Poona commenced from the time when Peshwa Bajirao I chose it as a suitable place for being made the capital of Maratha confederacy (A D 1735) Thenceforward Poona fast developed into a big city which was destined to occupy a proud position as one of the chief centres of political activities in India during the latter half of the 18th century Bajirao s son Balaji Baji Rao decided to raise a palace for the Peshwas just beyond these walls and selected the present site because here so goes the legend a hare successfully chased a dog Inside the walls was built a magnificent palace Shanwar Wada of which we get some idea from the plinth still standing The palace was a six storeyed building and was a splendid specimen of its type in the Deccan though it faded into insignificance by the side of similar buildings in the north and in the extreme south of the Indian peninsula

Sanivara Palace Delhi Gate

Under Savai Madhavrao Peshwa (1761 1771) an extensive menagerie (Shikarkhana) was maintained by the Peshwa in a Ramna or a park at the foot of the Parvati Hills

Poona after the fall of the Peshwas After the fall of the Peshwas in 1818 Poona became head quarters of a British town The Shanwar Palace of the Peshwa became the court house and in the Budhwar Palace was located the public library The old nobles landlords and priests lost all power and became povertystriken

The class which however appears to have retained its position and even prosper a bit consisted of Brahmins Prabhus and Shenvis who had clerical jobs They studied English helped the new administration in the work of consolidation and during the earlier part of the British regime the Collector s head clerk often wielded greater power than the Collector himself

The public had in these days heard of the Swarajya that was lost but had little idea of the Swarajya to come and credit must be given to Mahadeo Govind Ranade great as a judge of the Bombay High court scholar economist social reformer and a states man of all India reputation for giving an idea of the political future of the country Vishnushastri Chiplunkar, unlike Ranade, gave up his government service in order to have the necessary freedom to pursue his objective

Tilak and Agharkar did not enter government service at all Other prominent citizens of Poona were —

Mahadeo Shastri Kolhatkar, Professor of Marathi in the Poona College

Gopal Hari Deshmukh, writer of pamphlest in Marathi

Krishnaji Laxman Nulkar, opponent of Ranade

Ganesh Vasudeo Joshi, who about in 1869 preached the gospel of Swadeshi and of home made articles

The history of a nation is after the history of its nation—building Institutions and such Institutions were just trying to raise their heads in this city In 1871 when the Maharaja Scindia visited this city it is recorded that he gave money grants to the following institutions, (1) Library (2) Normal School for Women Teachers, (3) A Girl School, (4) The Beggar's Home in Navi Peth, (5) A private English School, (6) Dnyanprakash and Dnyanachakshu Press, (7) Deccan College, (8) Sarvajanik Sabha, (9) Vaktritvotejak Sabha and (10) an Association of Art Teachers

This brings us to the days of Vishnu Chiplunkar, Lokemanya Tilak and G K Gokhale, the last two being all India leaders of great reputation Tilak was also a great scholar, and an antiquarian

UNIVERSITY OF POONA

Though Poona has been the educational and cultural centre of Maharastra for a long time, and the citizens of Poona have been agitating for a separate University for over 25 years, the University was brought into existence by the first National Government of the Western Presidency Act XX of 1948, with Rt Hon ble Dr M R Jayakar, the eminent lawyer and jurist as the first Vice Chancellor

The jurisdiction of the Poona University extends over ten Maharashtra districts of the Bombay Province Of late, the colleges in the merged state of Kolhapur have also been affiliated to it Though Bombay City and Suburban District claimed to be parts of Maharashtra, they will continue to be served by the Bombay University, interspersed as they are with non-Marathi-speaking territory Some Marathi speaking areas in the south of the Province are also excluded from the jurisdiction of the University of Poona

Poona has ten colleges and four research institutions in which over 8,000 students attend courses of study leading to various university examinations. Over forty high schools cater to the needs of the large school-going population of the city, preparing students for the Secondary School Certificate Examination, Besides, a large number of voluntary cultural associations provide for the many sided activities of the people

Poona University as envisaged by the Jayaker Committee and constituted by the Legislature, is neither a purely affiliating type nor a purely unitary and teaching university, The whole of the post graduate teaching and research work in the entire university area will be conducted under its direct control But upto the intermediate stage in the Poona area and the graduate stage in outside places, instruction will continue to be given by the constituent and affiliated colleges subject only to the general supervision of the University In the post intermediate teaching organization in Poona again, it is not contemplated that *all the staff, equipment and buildings will belong to the university* But the university will be able to draw freely on these resources of the constituent colleges and institutions who will 'contribute' them to it The University will, no doubt, have its own library, laboratories and full time teaching staff But they will be mainly used for post graduate teaching and research in selected subjects For the present the university has decided to appoint seven professors and four readers in different subjects

Old Government House—now the University of Poona

The University, thanks to the Provincial Government, has been lucky of having the excellent site of the old Government House at Ganeshkhind as its permanent home Extending over an area of 750 acres and containing a number of auxiliary structures besides the imposing main building of the old Government House, this site is ideal for its pleasant and peaceful surroundings

One great feature of education in Poona has been the emergence of Educational Societies which are associations of private citizens, who have founded schools, colleges and other institutions, and thus have been instrumental in diffusing higher education.

DECCAN COLLEGE POSTGRADUATE & RESEARCH INSTITUTE POONA

The Dakshina Fund of the Peshwas which was used to remunerate deserving Brahmins was partly utilised by their successors the British in founding a Sanskrit College in 1821 which was afterwards expanded into a full grade Government College named Deccan College It acquired great reputation as a centre of Indology and great names like Martin Haug Kielhorn Bhandarkar Peterson etc were on the teaching staff of this College

THE DECCAN EDUCATION SOCIETY

The D E Society the first of its kind in this part of India is a private educational body conducting several schools and colleges in and outside Poona It owes its origin to the New English School started in 1880 by Messrs V K Chiplonkar B G Tilak and M B Namjoshi three great sons of Maharastra with the object of educating the people creating more facilities for education and bringing it within the reach of the common man

Fergusson College Situated now at the foot of the small range of hills known by its name the Fergusson College first came into existence in the old Gadre Wada in the city in the year 1885 The College is named after Sir James Fergusson the then Governor of Bombay as a tribute to his liberal and sympathetic attitude towards private education B A classes were opened in 1890 and B Sc in 1892 and the first student of the college taking B Sc degree was its future principal Mr (now Sir) Raghunath Purushottam Paranjapye The college shifted to its present site stretching along the two sides of the Mutha Left Bank Canal to the North West of the city in 1895 It has now become an institution having on its roll a number in the neighbourhood of 1800 a teaching staff in proportion to its number with a set of buildings given by various donors hostels for boys and girls quarters for principal and members of staff appropriate to its multifarious needs and altogether presenting an appearance of a university than of a college It is at present a constituent member of the Poona University contributing its resources in staff buildings and laboratories to the co ordinated instruction to the degree and post-graduate classes undertaken by it On the Arts side the college provided facilities for study in Languages Philosophy History Economics and Mathematics up to the M A stage until this year when the post-Intermediate teaching has been taken over by the University Similar provision was made in subjects of the science faculty such as Chemistry, Physics Botany Zoology and Geology Mention must be made of the encouragement and facilities afforded for the study of the Prakrit languages like Pali and Ardhamagadhi and foreign languages like the German On the science side the geological branch and the botanical garden deserve more than a passing reference

Willingdon College Sangli The College was inaugurated in the year 1919 in the town of Sangli and became a First Grade College in 1923 The College shifted to its present site in the year 1924 when the Main Building with the Boy s Hostel was completed

The College remained a purely Arts College for thirteen years degree classes in Science were opened in 1944 on the occasion of its Silver Jubilee

Standing on the borderland of two linguistic regions of Maharastra and Karnatak the Willingdon college has provided a centre for the development and fusion of the culture of Maharashtra and Karnatak and is likely to play an important role in the settlement of many thorny questions in the future

SHIKSHANA PRASARAK MANDALI POONA

The Shikshana Prasarak Mandali was founded as early as 1883 by a small but devoted band of primary teachers at Poona to commemorate the first anniversary of the late Vishnushastri Chiplonkar one of the pioneers in the field of modern Marathi literature Its first enterprise was the *Nutan Marathi Vidyalaya* at Poona started in 1896 In 1916 twenty years later the Mandali started its Arts College at Poona first known as new Poona College subsequently as *Sir Parashurambhau College*

In 1927 the Science department was added and until today the College offered instruction up to M A and M Sc standard In 1928 the Chiefsaheb of Jamkhindi with a view to perpetuate the memory of his revered father offered to the Mandali a generous donation of two lakhs and the Mandali named the College as Sir Parashurambhau College and offered to teach 50 Jamkhindi students free of all tuition fees The College has a strength of more than 2000 students

In the year 1935 a Radio Physics course was started in the Physics department of the S P College and the same is developed today into an independent *School of Radio Physics* and *Electronics* teaching courses in Advanced Radio Communication Wireless Telegraphy etc

In the year 1937 the Mandali started the *Ramnarain Ruia College* (Arts and Science) at Matunga Bombay and to-day it has a strength over 2400 students On the occasion of the Silver Jubilee celebrations of the S P College the Mandali started in the year 1941 a Commerce College at Matunga Bombay known as Ramniranjan Anandilal Podar *College of Commerce and Economics* and the *Tilak College of Education* at Poona It manages the Haribhai Deokaran H E School at Sholapur

THE MODERN EDUCATION SOCIETY POONA

The Society was founded in February 1932 by a group of educationists the foremost among these being Sir Cusrow Wadia and Sir Ness Wadia Presi dent and Vice President of the Society respectively The management of the Society is vested in a Senate composed of representatives of Donor Members and Workers The Senate works through two executive bodies viz. the Academic Council and the Finance Council

The Society established in June 1932 its Nowrosjee Wadia College as a full grade institution Now the College has become a constituent College of the Poona University and is doing post intermediate and post graduate teaching on its behalf The Society later on started a three year's Diploma course in Electrical Technology In addition to the normal work of under graduate and post graduate instruction in the science Courses research work has been undertaken in the Chemistry Physics Botany and Zoology departments of the Institute

THE MAHARASHTRA EDUCATION SOCIETY

This is the oldest educational society in Poona being founded in the year 1874 by Messrs Bhave and Indapurkar under the name Poona Native Institution with the object of imparting literary scientific and industrial education to the natives of Poona and the places nearby In 1922 the association renamed itself as the M E Society and with the march of time extended its sphere of activity in Poona and outside too Today the Society conducts ten institutions imparting instructions from the primary to the collegiate stage There are two big primary schools three big high schools the oldest of which had its Diamond Jubilee in 1935

COLLEGE OF ENGINEERING

The College of Engineering Poona is along the Colleges of Engineering in Sibpur near Calcutta and the Guindy College near Madras one of the three oldest engineering colleges in India It grew out of the Poona Engineering Class and Mechanical School which was started in 1854 in the Padamji compound Bhavani Peth for training of mechanics and overseers The hall of the main college building was completed in 1868 with Rs 50 000 provided by Cowasji Jehangir Ready Money and the college was opened under the name Poona Civil Engineering College

In 1879 in addition to the engineering classes an agricultural class and a forestry class were added to the College and the name of the College was changed in 1880 from the Poona Civil Engineering College to the College of Science A piece of land situated between Poona and Kirkee was acquired in 1880 as a Farm for the College The Agricultural Classes eventually were transferred to buildings on the Farm in 1907 and the separate Agricultural College was established

The College has produced many distinguished engineers whose names will be found on the Honours Board The greatest living engineer of the country, Sir M Visvesvaraya an ex president of Indian Science Congress is an alumnus of this College

COLLEGE OF AGRICULTURE

Imparting of higher education in the Bombay Province dates from the year 1878 when agricultural classes were held at the College of Science Poona There was a small farm of 70 acres Rapid progress during the following 30 years resulted in the establishment in 1908 of the Poona Agricultural College at Kirkee The College was transferred to the present site in 1909 and was affiliated to the Bombay University for B ag & M ag degrees It has a farm area of 175 acres for Agronomy and 343 acres for Animal Husbandry section There is also a museum of crops and a depot for sale of seeds etc

College of Agriculture Poona

The Ganeshkhind Botanical Garden functions as the Horticultural section of the College

The College of Agriculture has following sections —

(1) Agronomy (2) Animal Husbandry and Dairying (3) Economic Botany (4) Horticulture and Ganeshkhind Fruit Experimental Station (5) Agricultural Chemistry (6) Agricultural Engineering Physics and Mathematics (7) Agricultural Economics (8) Plant Pathology (9) Entomology (10) Veterinary Hospital (11) Agricultural Engineering (12) Mechanical Cultivation Engineering Section and (13) Soil Conservation Section

B J MEDICAL SCHOOL AND COLLEGE POONA

The B J Medical School was opened on the 1st November 1878 and during the 70 years of its existence did extremely good work both as regards instructions given to the pupils giving a course of three years and preparing Hospital Assistants up to 1906 as well as rendering Medical Assistance to the sick of the district as well as from other districts Several attempts to upgrade the school to a college have been made but plans took a concrete shape with the advent of Popular Ministry It is now proposed to house a first class Medical

College with its attached hospital The total estimate of the new project is about a crore and a half and the building work is already in progress

THE RANADE INDUSTRIAL & ECONOMIC INSTITUTE

The Ranade Industrial and Economic Institute was founded as memorial to Mahadeo Govind Ranade in 1908 out of a public contribution of a lakh of Rupees collected by G K Gokhale One of the objects of the Institute was to promote the spread of industrial technical and scientific knowledge in the country

In June 1949 the affairs of the Institute were handed over to the Poona University

RASAYAN NIDHI

Realising that the facilities for research in this part of the country were scarce Mr D B Limaye set aside a sum of Rs 1 000 and founded the Rasayan Nidhi—a registered trust in 1930 for the progress of chemical science both pure and applied The funds amount at present to over a lakh of Rupees

GOKHALE INSTITUTE OF POLITICS AND ECONOMICS

The Gokhale Institute of Politics and Economics was founded in 1930 as the result of a donation of nearly one lakh and twenty thousand rupees made for the purpose by Rao Bahadur R R Kale M L C of Satara to the Servants of India Society The Institute is located in the Servants of India Society s Home and its foundation was made possible by the splendid collection of books reports etc built up in the Servants of India Society s Library since the time of the late Mr Gokhale The main purpose of the Institute is to conduct investigations into economic and political problems of India the results of which may provide the basis for future constructive work

THE AGRI HORTICULTURAL SOCIETY OF WESTERN INDIA

The Society was started a little over hundred years ago by the parent institution at Calcutta The Royal Agri Horticultural Society of India who started similar institutions all over India and almost all of them excepting the one at Madras have become defunct. In 1855 the Society started its garden at Kirkee now known as the Ganeshkhind Fruit and Experimental Station Ten years later this was sold to Government with certain conditions In 1850, the Society took over the ugly swampy place of 33 acres and made it into the present Victoria Gardens at Bombay In 1869 these Gardens were handed over in trust to the Bombay Corporation In 1892 the Society took charge of the Empress Gardens and in 1893 the Bund Garden at Poona.

Empress Botanical Gardens —The gardens are situated east of the Race Course Government grants of Rs 12 000 are received every year at present The gardens have been very much improved of late

Experiments of all kinds are made advisory work is carried out and students not only from the local Colleges and Institutions but from out stations also visit the Gardens for botanical study practical work and commercial knowledge

Bund Garden —The gardens are well known being situated on one of the most frequented and popular spots in the whole of Poona on the south bank of the Mutha Mula river The grounds are tastefully laid out in terraces reaching to the river side and contain a fountain fernery and bandstand The gardens are beautifully planted and well kept

LORD REAY MAHARASHTRA INDUSTRIAL MUSEUM

The Lord Reay Maharashtra Industrial Museum Poona was founded by the Late Justice M G Ranade about sixty years ago and was managed by the Industrial Association of Western India Poona In the year 1888 the association had organized an inter provincial exhibition of indigenous articles and handicrafts of India and the Museum arose out of it The Museum later came under the control of Municipality but since the year 1896 remained defunct due to ravages of plague and famine It was revived by the Poona City Municipality in the year 1930

The different sections of the museum are —

(1) Information Bureau (2) Library and Reading Room in the Museum (3) Emporium of Arts and Crafts and (4) Museum Education

BHANDARKAR ORIENTAL RESEARCH INSTITUTE POONA

This Institute was inaugurated on the 6th of July 1917 on the occasion of the 80th birthday of Sri Ramkrishna Gopal Bhandarkar the great Orientalist of Western India It contains the follwoing departments

The Mahabharata Department The Manuscript Department, The Iranian and Semitic Department The Publication Department The Journal Department and The Library Department

BHARAT ITIHAS SANSHODHAK MANDAL

The Association of workers in the field of Indian historical research was established in 1910 by the late Mr V K Rajwade and Sardar K C Mehendale with the object of collecting material for history research to promote scientific study of history and to edit and publish books and manuscripts which would accelerate these objectives It has an excellent collection of original letters, manuscripts copper plates coins, old pictures, arms etc and offers exceptional oppor tunities to students of history There is also a collection of paintings, inscriptions sculptures etc, and a very large collection of historical records (*Daftar Khana*), containg several valuable individual collections

THE METEOROLOGICAL OFFICE

The India Meteorological Department was instituted in 1875 to coordinate combine and extend the work of various provincial meteorological organisations which had been established in the years between 1865 and 1871

The Technical Headquarters of the India Meteorological Department is located on the Ganeshkhind Road at Shivajinagar in a magnificent building conspicuous by its clock tower The present building in its grounds of over 10 acres were occupied in 1928

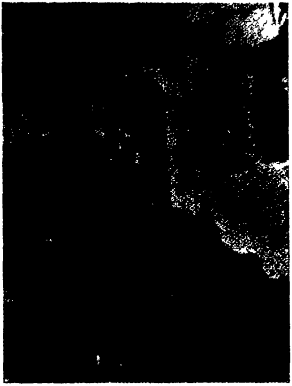
Amongst the offices the Deputy Director General for Forecasting is responsible for the issue of the Indian Daily Weather Report and Weekly Weather Report, the Monthly Weather Report and the Annual Weather Review and for the technical control of the forecasting work of the Department the supervision of meteorological telecommunications, Marine Meteorology and the Departmental Meteorological Training School The Deputy Director General for climatology and Geophysics is responsible for maintaining climatological statistics and records, rainfall registration organisation the issue of the statistical seasonal forecasts and the departmental publications and for Agricultural Meteorology and Seismology There is also a Section for Instruments and Supplies with a Workshop and a Laboratory Some of the activities of this office are briefly mentioned in the succeeding paragraphs

The Weather Central, Poona This Section is responsible for the All India Weather duties Its work comprises of the preparation and analysis of All India weather charts and the compilations of the various weather reports It issues the daily All India Weather Summaries which are diffused through the press and the radio and is responsible for the printed India Daily Weather Report In addition, it prepares extended zonal weather charts with synoptic data received from the Middle East, Russian Turkistan, the Far East, Australia, Islands in the Indian Ocean, South Africa, East Africa and Arabia It issues coded analyses of weather maps and detailed general inference about the weather over the Indian area for the use of the main Forecast Centres in the Country

Meteorological Service for Shipping Synoptic messages for the Fleet are issued by the Weather Central and are broadcast from the Met W/T station at Poona The Marine Section maintains close liaison with shipping interests Over a thousand weather logs from ships over the various sea areas are collected yearly, and their data are utilised in the synoptic study of important cyclones and later for compiling the climatology of the Indian waters

Training in Meteorology The Department maintains a Training School at Poona for the initial training of entrants into service in all grades, from observers to Forecasting Officers The courses of the junior staff take six months, and those for the entrants in the officers grade about a year

Climatology Climatological statistics both surface and upper air are maintained systematically commencing from the earliest years Normals of the usual meteorological elements for all the observatories in India and rainfall normals are published from time to time in the various departmental publications The preparation of climatological summaries climatological atlases and supply of climatological data are among the important duties of the section



Central Weather Office, Poona

Seasonal forecasts are now issued for the total monsoon rainfall and the total winter rainfall over specified areas

Hydrometeorology The need for developing the work of the department in the collection of rainfall and snowfall data, and for organising hydrometeorological observatories on a planned basis in the catchments of important rivers, has recently arisen in connection with the various multi-purpose projects of the Central Water-Power, Irrigation and Navigation Commission (CWNC) and those of the Provincial and State Governments To meet this need, work has been proceeding since 1946 on (1) improving the distribution of raingauges and snowgauges to suit different catchment areas, (2) installation of new hydrometeorological observatories in the different catchments, (3) inauguration of a system of snow surveys in representative places in the Himalayas and (4) coordination and collection of the already available hydrometeorological and climatological data A Hydrological Section has been opened in the Poona Office in this connection

Library The Meteorological Office Library is well equipped and contains about 4,500 books and 5,000 pamphlets relating to meteorology, physics, mathematics and allied subjects and about 22,000 volumes of serial publications

Agricultural Meteorology Agricultural Meteorology has been receiving the attention of the Department for many years, and in a sense ever since its establishment A special section for Agricultural Meteorology with a Central Agricultural Meteorological Observatory has been functioning in Poona since 1932 A good deal of work on various aspects of the micro climates of crops, soil physics, on plant physiology in relation to meteorological factors, on crop weather relationships and on analysis of meteorological data having a bearing on crops, has been done by this section , various sampling techniques have been developed for the statistical investigations , a number of new instruments for use in microclimatology and agricultural meteorology have been designed and constructed

Seismology Seismographs were installed at some of the principal observatories of the Department in 1898 The nucleus of a special seismological branch was formed in 1939, but the war intervened The expansion of the seismological organisation has been receiving renewed attention in Poona since 1947 The data of all the seismological observatories are published in the *Quarterly Seismological Bulletin*

A new aspect of work taken up is the planning of seismological observatories required in connection with the large scale multi purpose projects, like those of the Kosi and the Damodar rivers

A considerable amount of work has been done in the design and construction of sensitive seismographs for the observatories in India, and the setting up of recorders for microseisms in connection with storm detection and cyclone tracking has been taken up recently in the Central Seismic Observatory at Poona

Instruments and Supplies The development of the departmental workshop and Laboratory at Poona has received considerable attention In recent years construction of meteorological instruments has been undertaken, and repairs of all instruments, including barometers, are also done in the workshop The laboratory is fitted for the testing and calibration of all the instruments employed in the departmental observatories

Since the introduction of radio sonde work, the workshop has undertaken the manufacture of India Meteorological Department F-type radio-sonde instruments The receiving sets, the signalling meteorographs and components of the latter, the pressure, temperature and humidity indicators, the signalling equipment and the clock mechanism are all made locally New instruments suitable for Indian conditions and for special investigations are designed and constructed as required Experiments are successfully being made in radar wind finding, and other applications of the radar to the meteorological problems are being studied

CENTRAL WATERPOWER, IRRIGATION AND NAVIGATION RESEARCH STATION, POONA

The C W I and N R Station at Khadakwasla, 11 miles from Poona, opened as a provincial hydrodynamic station in 1916, and taken over as a central station by the Government of India in 1937 covers an area about 30 acres (and proposed to be extended to 136 acres when additional land is acquired) and is equipped to undertake model studies of rivers, canals and canal works and to give expert technical advice to the Central Government, Provinces and States in problems relating to river training and allied subjects Over 130 important investigations involving more than 2000 experiments have been carried out during the last 10 years These have included measures for the protection against breaches and floods in rivers , prevention of excess sand entering canals training of tidal and non tidal waters , the evolution of a number of important principles in connection with attracting, deflecting and repelling spurs or pitched islands for controlling rivers , factors determining the size and shape of meanders, relation between rainfall and run off, effect of sand and silt washed into the rivers when hill denudation occurs, the rate of silting of reservoirs , laws governing the movement of sand and sand factors affecting accretion and retrogression in rivers , littoral drift , the technique of model experimentations, model limitations and their correct interpretation etc

While the Station has always in progress many rigid and semi rigid model experiments it is specially renowned for its large scale model experiments, or advice without model experiments, on training of rivers, such as the Ganga at Hardinge Bridge, Sindhu at Sukkur, Yamuna at Delhi, Brahamaputra at Amingaon, Sarda at Banbassa, etc , Broadly speaking, the experiments have been of two kinds, specific problems and basic research , though frequently, specific problems have led in the course of their developments to results of a fundamental kind

POONA IRRIGATION AND RESEARCH DIVISION

The Irrigation Research Division (going under various names from time to time due to administrative changes) was formed in June 1916 under Mr (now Sir) C. C Inglis as Executive Engineer, with the main idea of (1) reclaiming lands heavily damaged by water-logging and salt by drainage and (2) investigating methods for the prevention of damage in the Deccan Canal Areas

KHADAKWASLA DAM AND MUTHA CANALS

The Khadakwasla Dam is constructed across the Mutha River at Khadakwasla about 11 miles from Poona Two canals—Mutha Right Bank Canal and Mutha Left Bank Canal—take off directly from the dam and draw the supply from the storage for irrigation Water is also supplied from the storage through the cannals to Poona and its extensions for domestic purposes It was the first of the large irrigation dams built in the Deccan and was completed in 1879, at a cost of Rs 39 lakhs

The total commanded area of the Mutha Canals system is 94,000 acres

THE MAHARASHTRA ASSOCIATION FOR THE CULTIVATION OF SCIENCE

The M A C S was actually established in 1946 for the purpose of 'the promotion of science including its practical applications to problems of national welfare" It maintains an Institute for scientific research and a library The laboratories provide facilities for work in the sections of Botany, Mycology and Plant Pathology, Micro biology and Bio chemistry, Entomology, Agricultural Chemistry and Soil Science The Research Institute and the Library are at present located in the basements of the Law College

The M A C S is now recognized by the Poona University as an Institution for specialized studies and research as a constituent part Post graduate teaching is now being carried on in the subjects of Botany, Micro biology and Entomology, both for the M Sc and Ph D degrees

FINGER PRINT IDENTIFICATION BUREAU, POONA

Finger print identification bureau, Poona is one of the three in the Bombay Presidency Of the existing natural sciences the system of Identification of Human beings, by means of Finger Prints is the most authentic and infallible

THE NATIONAL CHEMICAL LABORATORY, POONA

The National Chemical Laboratory is one of the most important link in the chain of National Laboratories which the Council of Scientific and Industrial Research has sponsored The Laboratory is situated on the Pashan Road (on an area of approx 470 acres) on a beautiful plateau The foundation stone of the Laboratory was laid on the 6th April 1947

Construction work of the Laboratory was started in February 1948, and a year after (March 1949), some sections of the Laboratory were moved from Delhi

The scientific work of the National Chemical Laboratory is to be conducted through the following seven divisions —(1) Inorganic and Analytical Chemistry, (2) Physical Chemistry, (3) Organic Chemistry, (4) Chemistry of High Polymers, (5) Biochemistry and Biological Evaluation, (6) Chemical Engineering and (7) Survey & Intelligence

In addition to these seven divisions, there is a division for administration of the laboratory, which may undertake standardization and production of pure chemicals

The staff originally proposed for the laboratory included the Director, 8 Assistant Directors, 43 Research Officers, and 64 Research Assistants, in addition to administration staff and services It is hoped the laboratory will be working in full strength in the course of 1950

NATIONAL DEFENCE ACADEMY, KHADAKVASLA

The genesis of the National Defence Academy can be traced to the Government of India's decision in 1945 that the most suitable form that the Indian National Memorial of World War II could take was a Military Academy on the lines of the United States Military Academy at West Point, with this difference that, whereas West Point catered for the education and basic training of only army officers the Indian Academy should be an Inter Services training centre In this picturesque and historic setting of Shivaji's exploits will spring up the Academy township of about 15,000 souls, devoted wholly to the training of young officers of the three Services

SERVANTS OF INDIA SOCIETY, POONA

The Servants of India Society, was founded by the late G K Gokhale on June 12 1905 Its objects are to train national missionaries for the service of India and to promote by all constitutional means, the interests of the Indian people Its present strength is 24 members The Society has its headquaters in Poona with branches at Madras, Bombay, Allahabad and Nagpur, and other centres in India

ARMED FORCES MEDICAL COLLEGE (A F M C)

The Armed Forces Medical College came into existence in May 1948 by the fusion of Central Military Pathological Laboratory, Army Transfusion Centre, Army School of Hygiene, Army School of Radiology, Army Medical Training Centre

ORDNANCE FACTORIES AND ALLIED ESTABLISHMENTS, KIRKEE

Ammunition Factory This Factory was built in 1869, and about the same time another Ammunition Factory was also opened at Dum Dum, Bengal These two Factories served to produce all requirements till the Factory at Dum Dum was closed in 1925 and manufacture of ammunition was concentrated at Kirkee

High Explosives Factory High Explosives required for the filling of shells, bombs etc used to be imported from abroad till their manufacture was established in the H E Factory When the factory Rationalisation Committee was set up in November, 1937 by the Ordnance Department, the Factory for the manufacture of High Explosives formed one of the projects under consideration

In view however of the fact that the High Explosives will be required by the Ammunition Factory at Kirkee, the choice of site for the factory fell to Kirkee The foundation stone of the first building of this Factory i e its laboratory was laid by Mr G S Butler, Director of Ordnance Factories on 11 1 1940 The laboratory and the Stores section started operating from September, 1940 and the Acid section in January 1941

T D E (A) Kirkee The origin of this establishment dates back to 1911 when Inspection Section and and the Proof section were inaugurated at Kirkee under Assistant Inspector of Ammunition

As a result of a policy discussion to separate Inspection of Factory outturn from other important activities of the establishment, i e design, development and investigation, a new establishment designated as Chief Inspectorate of Ammunition was created in 1943

In addition to the above T D E (A), Kirkee has got a Service Laboratory where ammunition are sectioned and broken down under precaution for special investigation It has also an X Ray department having two X Ray plants

Inspectorate of Military Explosives, Kirkee The origin of this establishment dates back to 1908 when a laboratory for inspection of explosives (Propellants) was opened in Nainital (U P) under Mr A Marshall, F I C designated as Chief Chemical Examiner

Artificial Limb Centre

At present this is the only institution of its kind in the East It is being planned eventually to be a self contained unit with all the necessary equipment The Director General of Health Services (India) is anxious that the civilian amputees should be entertained here and requests have also been received from the Governments of Burma and Ceylon for the supply of artificial limbs to their disabled soldiers

Electrification of Bombay—Poona & Igatpuri Main Lines and Bombay Suburban Lines of the G I P Railway

The inland traffic between the great Port of Bombay and North East, East, and South India is carried by the G I P Railways At Kalyan junction which is about 33 miles from Victoria Terminus the main lines bifurcate into North East and South East directions The Railway tracks from Victoria Terminus to Igatpuri on the North-East section, a distance of about 85 miles, and to Poona on the South East section distance of about 120 miles, are equipped for electric traction and all passenger and goods traffic is electrically hauled

The travelling public between Bombay and Poona and Bombay and Igatpuri derives several advantages out of electrification The travelling time from Bombay to Poona which amounted to nearly 6 hours in the steam days has now been cut down to only 3 hours by fastest train called the 'Deccan Queen' The other advantage of electrification is the clean travel because of elimination of smoke, cinders and fumes This advantage is specially of great value when passing through 26 tunnels on the Bhore Ghats and 10 tunnels on the Thull Ghats There is no more that feeling of suffocation and unpleasantness that used to be caused by smoke, cinders and fumes of steam traction days

New Line of Communication Between Deccan Plateau and Bombay

An interesting scheme, first of its kind, in the Bombay Presidency is being developed by the Naneghat Funicular Tramway & Transport Company, Limited of Poona

Three hundred square miles of fruit and vegetable land round Junnar has no direct outlet except by the round about way by road upto Talegaon and by rail to Bombay By the present route Via Talegaon, Junnar is 143 miles from Bombay The new route Via Naneghat will shorten this distance to 97 miles only Apart from saving of the distance, time and labour involved in three transhipments will be saved *

---

*Our thanks are due to Prof G R Paranjape for supplying us with the materials in the preparation of the article (Ed—*Science & Cul.*)

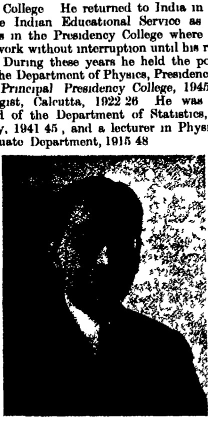
SHORT LIFE SKETCHES
OF THE
General President and Sectional Presidents

Thirty-Seventh Session of the Indian Science Congress Association, Poona

PRASANTA CHANDRA MAHALANOBIS

General President

BORN in Calcutta in 1893, Professor Mahalanobis graduated from the Presidency College in 1912 with honours in Physics He joined King's College, Cambridge, in 1913, passed the Mathematical Tripos Part I in 1914, Natural Science Tripos Part II in Physics in 1915, and was awarded a senior research scholarship of King's College He returned to India in 1915 and joined the Indian Educational Service as Professor of Physics in the Presidency College where he continued his work without interruption until his retirement in 1948 During these years he held the post of the Head of the Department of Physics, Presidency College, 1922 42, Principal Presidency College, 1945 48, and Meteorologist, Calcutta, 1922 26 He was also the first Head of the Department of Statistics, Calcutta University, 1941 45, and a lecturer in Physics in the Post graduate Department, 1915 48



He was elected a Fellow of the Royal Society in 1945, and was awarded the Weldon Medal and Prize (for Biometry) in the University of Oxford in 1944 He is a Foundation Fellow of the National Institute of Sciences of India, and a Fellow of the Indian Academy of Sciences, the Royal Statistical Society, London, etc.

Prof Mahalanobis founded the Indian Statistical Institute in Calcutta and has been its Secretary from the very beginning in 1931, and has been the editor of *Sankhya* the Indian Journal of Statistics since its inception in 1933 He is the Vice President of the International Institute of Statistics from 1947, and foundation Vice President of the International Biometric Society from 1947 He was President of the Anthropological Section in 1925 and of the Mathematics and Statistics Section in 1942 of the Indian Science Congress He worked as the General Secretary of Visvabharati from its inception in 1921 to 1931, and as General Secretary of the Indian Science Congress Association, 1945 48

Prof Mahalanobis was a member of the Indian Delegation to the Royal Society Scientific Conference in London, Cambridge, and Oxford in 1946, leader of the Indian Delegation to the World Statistical Congress, Washington D C, U S A in 1947, member of the Indian Delegation to the United Nations Scientific Conference for the Conservation and Utilization of Resources in New York in 1949, the Indian delegate to sessions of the International Statistical Institute, in Berne, and of the International Biometric Conference and the International Population Union Geneva in 1949 He has attended four sessions of the UN Statistical Commission as the representative of India, and, in his personal capacity, presided over three sessions of the UN Sub Commission on Statistical Sampling since its establishment in 1947 Since April 1946 he has gone abroad on scientific tours on nine occasions and has delivered lectures and attended conferences in many countries in Europe and America, and visited Turkey in 1948 and 1949 as a guest of the Turkish Government to give advice in statistical matters He travelled extensively in Europe in 1926-27 with Rabindranath Tagore He has published about 130 research papers and reports on statistical subjects

Prof Mahalanobis is now the Statistical Adviser to the Cabinet, Government of India, Chairman of the Committee of Departmental Statisticians in Delhi, and Chairman of the National Income Committee, Government of India He is the Director of the Indian Statistical Institute, Calcutta, and Chairman of United Nations Sub Commission on Statistical Sampling

Great as his contributions are to the practical applications of statistical methodology the pioneer services he has rendered in creating of a strong school of advanced statistical study and research in India have been greater still We wish him many more years of fruitful activity

NALINI MOHON BASU

President, Section of Mathematics

PROFESSOR BASU received his early school education at Gaibandha in the district of Rangpur in North Bengal and passed the Entrance Examination of the Calcutta University in 1908 He graduated in science, with Honours in Mathematics from the Scottish Churches College, Calcutta in 1912 and passed the M Sc Examination in Mixed Mathematics from the Presidency College, Calcutta, in 1914, standing first in the First Class in both the examinations After serving for sometime as a teacher in the C M S College, Calcutta, Prof Basu joined the department of Applied Mathematics at the University College of Science and Technology, Calcutta, in 1916 as Sir Rash Behari Ghosh Research Scholar, and later served the Calcutta University as a lecturer In 1921 he joined the Dacca University as a Reader in Mathematics and became Head of the Department in 1923 He was awarded the degree of Doctor of Science by the Calcutta University in 1923 on a thesis entitled "On the Diffraction of Light by Cylinders of large Radius and some Problems in the Dynamics of Particles and Fluids" During 1928 30 he prosecuted higher studies and Research at the University of Göttingen in Germany and also visited among others the Universities of Berlin, Paris, Cambridge and Edinburgh In 1931 he was appointed to the Professorship of Mathematics at Dacca University and resigned the same in August 1948 in order to join the post of Professor and Chairman of the Department of Mathematics at Aligrah University which posts he has been holding since 1st September 1948. His scientific contributions are mostly in the domain of Applied Mathematics, chiefly in Dynamics and the Theory of Elasticity

P V SUKHATME

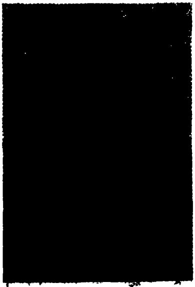
President, Section of Statistics

BORN on the 27th July, 1911 Dr Sukhatme was educated at the Maharashtra Education Society's High School and Fergusson College, Poona He graduated in 1932 with Mathematics as principal and Physics as subsidiary subjects In 1933 he joined the University College London, where he worked under the guidance of Professors E S Pearson and J Neyman and took his Ph D in Statistics

In 1935 he joined Rothamsted Agricultural Experiment Station, England and later Garton Laboratory, London, where he worked under the guidance of Prof R A Fisher on the Combinatorial Analysis and extended the application of Bi Partitional Functions to the solution of Moments and Product Moments for samples from a finite population and other problems He was subsequently awarded D Sc degree of London University on the basis of this thesis His research on Bi-Partitional Functions was published as a *Memoir* by the Royal Society of London in their Philosophical Transactions, Series 'A', 1938

On return to India in 1936 he joined as Statistician, Indian Institute of Sugar Technology Kanpur

Later in 1938 he took up the post of Statistician to the Economic Adviser to the Government of India but soon went over to Calcutta to take up the appointment of Assistant Professor of Statistics in the All-India Institute of Hygiene and Public Health



In 1940 Dr Sukhatme joined the Indian Council of Agricultural Research as its Statistician and later in 1945 became Statistical Adviser to the Council In addition to his normal functions of advising the Council and the Provincial Government on all statistical matters concerning Agriculture, he has organised a laboratory where post-graduate students work for the University research degrees He acts as Sampling Expert to the Government of India and in this capacity has to initiate, plan and execute sample surveys for collecting such statistics as the Government need from time to time

Dr Sukhatme has published over 40 original papers in various journals in India and abroad His earlier researches covered somewhat wide field of theoretical statistics including sampling distributions and combinatorial analysis Since 1940 they were restricted to sample surveys in agriculture and statistical methods in animal husbandry The technique of random sampling for estimating crop yields as developed by him is today in operation on all principal crops over the major part of India

Dr Sukhatme is a Fellow of the National Institute of Sciences of India and the Indian Academy of Sciences, Bangalore

He is editor of the *Journal of the Indian Society of Agricultural Statistics*, and Vice President of the Standing Advisory Committee on Statistics of the Food and Agriculture Organisation of the United Nations

Dr Sukhatme represented India at the International Conference on Statistics at Washington, and led the Indian Delegation at the Statistical Conference in South East Asia in Singapore, in 1947 and 1948 respectively

He has been appointed director of the International School on Censuses and Statistics, 1949 and visiting Professor, Iowa University, United States, 1950

R N GHOSH

President, Section of Physics

DR R N GHOSH was born in 1892 He graduated in 1916 from Ewing Christian College, Allahabad and later took the M Sc degree from Muir College, Allahabad The interest in acoustics created by Dr. P H. Edwards and the publication of articles on 'Sound due to impact' and vibrations of strings with the beautiful photographs of vibration curves from Bowbazar (Calcutta) allured his mind to proceed to that temple of research viz, The Indian Association for the Cultivation of Science, Calcutta Prof C V Raman admitted him to work in the Association, and gave lessons on the technique of sound photographs His experiments on the spheroidal state had a spectacular effect and Prof Raman used to take interest in the demonstration of the horizontal oscillations of star pointed mercury drops when made to vibrate vertically The spheroidal drop of water rested on the cushion of water vapour, and it could be easily demonstrated to an audience that whenever the thickness of the cushion varied periodically, the drop would take the form of star The coupled oscillations were maintained by their mutual reactions Similarly under the direction of Prof Raman a ripple was constructed and prefected which could show the beautiful Echelon diffraction effects, and the anomalous acceleration phase at a focus This was in 1919 He joined the staff of Muir Central College as a demonstrator at a time when there was hardly any academic or research activity, but he continued to work on acoustical problems About this time (1920) Raman and Banerji contributed an article in the *Proc Roy Soc* regarding the impact of pianoforte hammer on the string and the experimental determination of the duration of impact at various distances Raman and Banerji considered the hammer as an inelastic mass, the theory given was a general one applicable to any point of impact, while Kaufmann's theory for hard hammer was true for small distances Shri Ghosh extended Kaufmann's theory (1895) to the case of elastic hammer an account of which is given in Handbuch der Physik Vol 8 (Acoustics) This work was followed by more extended theories by Prof M Ghosh and others Later Dr Ghosh finalised his theory (*Journal of Acoustical Society of America*, 1936) for any distance when reflection does not occur from the farthest end with the help of Heaviside Operational Calculus In the same manner the problem of clarionet and flow of air through the chink of periodically varying width was solved with the help of Heaviside calculus These results find immediate application to the sound produced by the vibrating reed in the case of harmonium It seems that in all these cases the flow is determined by the small viscosity of air, and the velocity of flow is proportional to the difference of pressure

At a time when there was hardly any auditorium consciousness in India, Dr Ghosh started the work for the search of a suitable indigenous material for use as sound absorbing material, and control of sound or reverberation From a practical point of view the importance of study of these subjects cannot be over estimated Some materials prepared by the Forest Research Institute, Dehradun were tested and found satisfactory, but unfortuntely industrialists depend more upon foreign imported goods Dr. Ghosh was greatly encouraged in his researches by Prof M. N Saha (then at Allahabad) Prof Saha gathered round him a team of workers in the Physics department of

Allahabad University and the physics department was full of activity and scientific life D S Kothari P K Kichlew R C Mazumdar and N K Sur and many others are the valiant representatives of the team Side by side with the work on thermal ionization and researches in spectroscopy Dr Ghosh pursued his work on acoustics and often extended his activities into the domain of atomic physics

He was awarded the degree of Doctorate of Science by the Allahabad University on his thesis on Vibrations of String Violin in 1926 and was elected Fellow of the National Institute of Sciences of India and the Acoustical Society of America Dr Ghosh is now interested in the ultrasonic absorption in liquids and the liquid state

J K CHOWDHURY

President Section of Chemistry

BORN in 1892 at Lamchar in the District of Noakhali Bengal Dr J K Chowdhury was educated at Krishnath College Berhampore and Presidency College Calcutta From 1916 to 1920 he was at the Assam Oil Company Digboi and served as the Chief Chemist of the Company In 1921 he proceeded to Berlin for higher studies in Chemistry and carried out researches on cellulose in Kaiser Wilhelm Institute for Fibre Chemistry under Professor R O Herzog and took his D Phil from the Berlin University in 1924 After completion of his studies at Berlin he made extensive tour to visit industrial organisations and research institutes in the Continent

Coming back to India Dr Chowdhury was appointed Reader in Chemistry in the Dacca University in 1925 and thereafter succeeded Dr (now Sir) J C Ghosh as Professor and Head of the Department of Chemistry in the same University He was later elected Dean of the Faculty of Science and a member of the Executive Council of the University

Retiring from the Dacca University in 1947 he joined the Bose Research Institute Calcutta in the same year as Head of the Department of Chemistry the post he is holding at present

Dr Chowdhury is a member of the Fuel Research Committee and the Cellulose Committee of the C S I R the Technological Subcommittee of the I C J C and the Chemistry Committee of the I C A R He was also a member of the now defunct Board of Industrial Research of the Government of undivided Bengal His researches cover various fields such as cellulose chemistry of coal oil and fats preparation and properties of various mixed adsorbents and recovery of sulphur from sulphur bearing materials The school of cellulose research in Dacca University owed its success largely to his initiative and personality

J COATES

President Section of Geology and Geography

MR J COATES was born in 1903 He was educated at Clifton College Bristol where he was a Mathematics scholar and then studied Oil Technology at Royal School of Mines from which he obtained the diploma of Associateship in 1923

He joined the Geological Staff of the Burmah Oil Company in 1923 a service in which he still continues and spent his early years partly on oilfield development in the Burma oilfields (Yenangyaung Singu and Yenangyat) and partly in geological exploration mapping in Arakan Chittagong Assam the Punjab N W F P Baluchistan Sind and Burma During this period he specialised for six months on Sedimentary Petrology of which the systematic application in India was at that time still in its infancy From about 1929 until 1938 he was occupied almost entirely on oilfield development work in the Burma oilfields where he was particularly active in gas conservation and Secondary Recovery problems From 1939 he reverted

mainly to supervisory and compilation work on exploration geological mapping, and after the demolition of the Burma oilfields in 1942, he came to India and assumed charge as the Burmah Oil Company's Senior Geologist in this country

He is a member or fellow of various learned societies in India and abroad, including the National Institute of Sciences of India, the Geological Society of London, and the Institute of Petroleum His published work includes a technical paper on Section Construction, and some semi popular expositions of the practice of Petroleum Geology

P MAHESWARI

President, Section of Botany

PROF P MAHESHWARI was born on November 9, 1904 at Jaipur in Rajputana He took the B Sc and M Sc degree of the Allahabad University in 1925 and 1927 respectively From 1927 to 1930 he worked as research scholar at the Allahabad University and was awarded the D Sc degree in 1931

Prof Maheshwari began his teaching career as Lecturer in Botany at the Agra College (1930 37) and the University of Allahabad (1937 39). In 1939 he was appointed Reader in Botany and Head of the Biology Department at the Dacca University and was later promoted to a Professorship He was also the Dean of the faculty of Science at Dacca University In March 1949 he accepted the Professorship of Botany of the newly opened Department of Botany of the University of Delhi

Prof Maheshwari's chief interest lies in angiosperm morphology and embryology on which more than 150 papers have been published by him and his collaborators and he has built up an active school of embryological researches in India He is the author of an advanced text book on the Embryology of Angiosperms (*in press*) to be published by the McGraw Hill Book Company of New York and London He is also the editor of another book entitled 'Manual of Embryology' to be published by the Chronica Botanica Company

Prof Meheshwari's work has received considerable recognition both in India and abroad In 1934 he was elected fellow of the Indian Academy of Sciences, and in 1935, fellow of the National Institute of Sciences, India In 1947 he was made Corresponding Member of the American Botanical Society and Honorary foreign fellow of the American Academy of Arts and Sciences Recently he has been elected one of the vice Presidents of the International Botanical Congress to be held at Stockholm in 1950, and Chairman of the Section of Plant Embryology of the International Union of Biological Sciences

Prof Maheshwari has travelled widely both in Europe (1936 37) and America (1945 47) He has a personal collection of material and literature on angiosperm embryology which may well be the richest in the whole of Asia

B C BASU

President Section of Zoology and Entomology

B. C BASU was born at Protapnagar in the District of Hooghly West Bengal He matriculated from the Sekendurpur School in 1917 graduated in 1921 and took his M Sc Degree in Zoology from the Calcutta University in 1923

In 1924, he joined the late Dr C A Bentley's Malaria Research Laboratory where he had his training in Malariology and Parasitology After serving for sometime as Entomologist, Bengal Public Health Department, he was appointed Entomologist, Spirochaetosis Transmission Enquiry at the Calcutta School of Tropical medicine In 1931 he was transferred to the post of Entomologist, Malaria Transmission Enquiry at the same Institute In 1939 Dr Basu was appointed Assistant Entomologist, Indian Veterinary Research Institute, Mukteswar, and was later transferred to Izatnagar (Barilly) as Research Officer (Entomology)

For the last twenty five years Dr. Basu is actively engaged in and has acquired wide experience in medical, public health and animal health researches and had the chance to work in close collaboration with eminent workers like, Col Knowles, Col Action Sir R N Chopra, Dr Strickland and others He conducted research on various aspects of human and avian malaria, human filariasis, rat-bite fever, relapsing fever, avian spirochaetosis, fowl cholera, anthrax, rinderpest and surra He has extensive experience in survey and control of diseases and the transmitting vectors He is a man with originality with keen power of observation He published more than fifty research memoirs of high order (some of them being jointly with Col Knowles and Sir R N Chopra) dealing with transmission parasitology, treatment, prophylaxis disease and insect control etc His works have been highly appreciated by workers in the field both in this country and abroad He was awarded the D Sc degree of the Calcutta University in 1935

Dr Basu was a teacher of D T M , D P H , and L T M courses of the School of Tropical Medicine and is now a teacher to the post graduate students of Indian Veterinary Research Institute

He is connected with several academic societies and is on the editorial boards of Zoological and allied journals He was for sometime a member of the Council of the Indian Science Congress Association and was invited to organize the Pan Asiatic Conference of Economic Entomologists

C VON FURER HAIMENDORF

President Section of Anthropology and Archaeology

DR CHRISTOPH VON FURER HAIMENDORF, Ph D was born in Vienna (Austria) in 1909 He studied anthropology and prehistory at the University of Vienna and at the London School of Economics and Political Science He started his academic career as lecturer in anthropology at Vienna, and from 1935 to 1937 he held a research fellowship of the Rockefeller Foundation which enabled him to undertake anthropological research work in the Naga Hills and in the Sadiya Frontier Tract In 1939 he came for the second time to India and began an anthropological survey of the aboriginal tribes of Hyderabad This work occupied him until 1944 when he accepted service under the External Affairs Department of the Government of India and was entrusted with anthropological investigations in the Balipara Frontier Tract, which involved also geographical exploration along the Indo-Tibetan border In 1945 he returned to Hyderabad State and was appointed to the dual position of Adviser for Tribes and Backward Classes and Professor of Anthropology in the Osmania University In his capacity as Adviser to Government he was in charge of extensive schemes for the rehabilitation and education of aboriginals and other backward classes, and became the first head of the Social Service Department He recently relinquished his post as Professor of Anthropology in the Osmania University in order to join the School of Oriential and African Studies in the University of London But he retains his position as Adviser to the Hyderabad State Government on tribal affairs and now divides his time between England and India His major publications in book form are *The Naked Nagas* (London 1939), *The Chenchus* (London 1943), *The Reddis of the Bison Hills* (London 1945), *Tribal Hyderabad* (Hyderabad 1946), *Explorations in the Eastern Himalayas* (Shillong 1947), *The Raj Gonds of Adilabad* (London 1948)

M V RADHAKRISHNA RAO

President, Section of Medical and Veterinary Sciences

BORN in a village in Guntur District (Andhra) in 1903, Dr Rao had his early education in Tenali and Andhra Christian College, Guntur He graduated in medicine from the Medical College, Vizagapatam, where he had a brilliant career After he got his degree he worked for nearly two years as a post graduate in the Medical College and King George Hospital, Vizagapatam Subsequently, he took to whole time research work on disease of the liver in children Working later as a research scholar under the Lady Tata Memorial Trust, Bombay, he was awarded the Ph D , Degree by the Faculty of Medicine of Andhra University

At the invitation of Sir Robert McGarrison, Dr Rao joined the staff of the Nutrition Research Laboratories, Coonoor, where he worked for nearly seven years and carried out his research work on human nutrition His work on the skin manifestations in Vitamin

A deficiency won him a reputation in foreign countries.

Since 1941, Dr Rao has been working in the Bombay Medical Service as Assistant Director and head of the Department of Nutrition and Experimental Pathology in the Haffkine Institute He has organized a department of nutrition at the Institute, where all laboratory investigations on human nutrition are carried out for the Government of Bombay

In July 1947, Dr Rao proceeced to the United Kingdom at the invitation of the Medical Research Council of Great Britain where he worked in the University College Hospital Medical School, London, on liver disease of nutritional origin Later, on behalf of the Government of Bombay, and the Government of India, he visited the leading nutrition research institutions in the United Kingdom, United States of America, Canada and Australia to study the recent advances in the field of human nutrition During this period he contacted the leading scientists in this field and had a first hand understanding of the measures adopted in the different countries to improve the nutritional status of the population

Dr Rao was one of the official delegates who represented the Government of India at the International Congresses on Tropical Medicine and Malaria held in Washington in May 1948 where he read a paper on "Some common deficiency diseases in India" before the section on nutritional diseases of the tropics

Since his return to India in July 1948, Dr Rao has been appointed as the nutrition expert to the Government of Bombay and is now the head of the newly established Department of Nutrition of the Government of Bombay

Dr Rao was elected a member of the Pathological Society of Great Britain and Ireland in 1940, a Fellow of the National Institute of Sciences of India in 1945 and member of the Nutrition Society of Great Britain.

Dr Rao has published about 50 scientific papers, both in Indian and foreign journals, on medical research carried out by him in this country and abroad.

RAM LAL SETHI

President, Section of Agricultural Sciences

RAI BAHADUR RAM LAL SETHI passed M Sc. (Punjab) in 1917 and B Sc (Agri) Edinburgh in 1921 Soon after he was appointed to the Indian Agricultural Service by the Secretary of State for India in London and was posted as Economic Botanist to the Government of the U P in Kanpur, where he took charge of the section comprising both of research and teaching in the Agricultural College In 1935 he was appointed as officer in charge of the Sugarcane Research Station at Shahjahanpur and took over charge of varied investigations on that important cash crop in the U P When Sir John Russell, Director of the Rothamsted Experimental Station in England was invited by the Imperial Council of Agricultural Research to review the work of the Council on agricultural research in India in 1936 37, Mr Sethi was appointed his Secretary In this capacity he travelled throughout the country and reviewed the research work of various agricultural stations along with Sir John Russell who submitted his report to the Government of India in 1937 Since he has successively held the posts of Assistant Agricultural Commissioner with the Government of India, Professor of Agriculture and Principal, Government Agriculture College at Kanpur, and Cane Commissioner to the Government of the U P In the latter capacity he took charge of the work of development of sugarcane throughout the province and its supply to the sugar industry.

In 1945, Mr Sethi was appointed Director of Agriculture in Sind, and prior to the partition of the country he was appointed Agricultural Commissioner with the

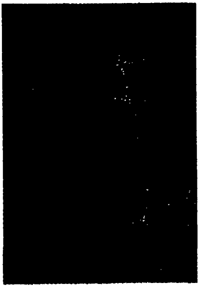
Government of India a post he is still holding Mr Sethi was awarded the title of Rai Bahadur in June 1937 as a reward for continued service of merit in the Department He has published about 24 scientific papers on different agricultural subjects The chief crops on which research work has been carried are sugarcane rice and fodder crops

He is 55 years of age

KALIDAS MITRA

President Section of Physiology

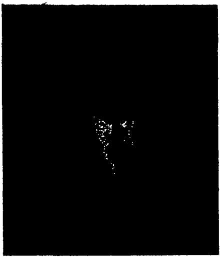
DR KALIDAS MITRA was born in December 1899 and graduated in medicine in 1925 from Calcutta with Honours in two subjects and was awarded Sutherland medal Having served for a year as a House Surgeon Medical College Hospitals Calcutta he joined the Bihar Public Health Service in 1927 and served the health department in various capacities His Reports on Malaria published by the Government of Bihar have been well spoken of He obtained D P H from Calcutta (1931) and D T M & H London (1936) in a record period of three months and later joined the division of Medical Statistics and Epidemiology at the School of Hygene London under Prof M Greenwood F R S After his return from Study leave in 1937 Dr Mitra was appointed Nutrition Officer Bihar His researches on Nutrition and Medical Statistics have been referred to in scientific journals monographs and text books In 1944 he served the Government of Bengal in connection with measures for famine relief and joined the Ministry of Food New Delhi in 1945 as the Director of Nutrition In 1943 he presided over the Bihar Provincial Medical Conference and represented India in 1946 at the Nutrition Conference of the S E Asian countries in Singapore In 1946 he was deputed to work on the staff of the Bureau of Animal Nutrition Rowett Research Institute Aberdeen and since then serving as adviser in Nutrition to the Government of India Dr Mitra is a Fellow of the National Institute of Sciences of India



KALI PRASAD

President Section of Psychology & Educational Sciences

KALI PRASAD had a brilliant academic career at the Allahabad University and was invited to take up lectureship in Philosophy at Lucknow University in 1924 Since then he has been lecturing on various branches of Psychology History of Philosophy and Epistemology and also on Indian Philosophy to the graduates and Post graduates Since April 1948 he is the Professor and Head of the Department of Philosophy and Education During the last 25 years Prof Prasad has expanded the Department by starting diploma and degree courses in Education and M A course in Experimental Psychology served as a member of the various university bodies including its Executive Council and as Honorary Librarian Lucknow University Library



Prof Prasad was invited by the Government of India to work on a committee for the preparation of Central Institute of Psychology He was also invited by the International Congress in Philosophy at Rome in 1946 Again in 1949 he was invited to the International Congress in Humanistic studies at Rome He has published a large number of papers in journals in India and abroad and has published a book The Psychology of Meaning

There are a number of research students working in the Department under him He started research on the problem of the Fatigue and Efficiency in Textile Industries about 3 years ago first at the instance of the Indian Research Fund Association and now with the support of the U P Government The work is the pioneer work in Industral Psychology in this country At present he is engaged in problems of Social Psychology

Prof. Prasad was the joint Secretary of the Indian Philosophical Congress in 1929 and was president of the Psychology Section of the India Philosophical Congress at Nagpur Session in 1936. He has been on the editorial board of the Penal reformer, a U.P. Government publication and also the *Indian Journal of Psychology*, the official organ of the Indian Psychological Association (Calcutta).

He is now 48.

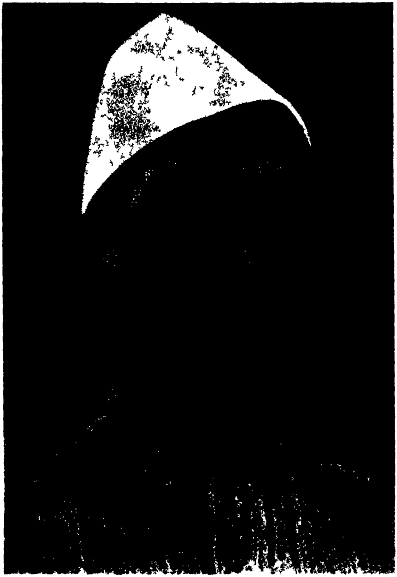
D. R. MALHOTRA

President, Section of Engineering and Metallurgy

DR. D. R. MALHOTRA was educated at the Punjab University Lahore, Massachusetts Institutte of Technology at Boston and at the Harvard University from where he graduated with high distinction in Industrial Chemistry and Metallurgy. He was employed by the Atlantic Dye-Stuff Company, New Hampshire, Portsmouth, as Chemical Engineer before returning to India. He worked with the Tata Iron & Steel Company at Jamshedpur as their Research Metallurgist from 1925 to 1931. He was awarded Carnegie Research Scholarship of £ 100 by the Council of Iron & Steel Institute, London for conducting Industrial Meteallurgical Research in this country. This British Scholarship for Meterllurgical Research is considered to be the highest distinction in the field of Metallurgy. He joined B.B. & C.I. Railway Company in 1931 as their Chief Chemist & Metallurgist. He was elected Chairman of Railway Chemist & Metallurgist Committee of Indian Railway Conference Association, New Delhi in 1942 and since then was elected Chairman unanimously every year. He was appointed Officer on Special Duty, Railway Board, in 1945 in which capacity he visited all the Railway centres in this country along with Mr. Hancock —a British Water Softening Expert of London Midland & Scotish Railway who was invited by the Government of India. Since 1942 he has been a member of the Metals Research Committee of the Council of Scientific & Industrial Research and also served as a member of the Non-Ferrous Industries Panel of the Department of Planning & Development. Dr. Malhotra was elected Chairman of the *Ad Hoc* Committee of Indian Railway Conference Association for the reclamation of used oils. During the war he was responsible for conducting metallurgical research on behalf of the Railway board as well as for the Council of Scientific & Industrial Research for which necessary funds were placed at his disposal.

The following Research problems of great national importance were entrusted to him for which satisfactory reports were furnished :—(a) Convservation of Non-Ferrous Metals; (b) Manufacture of high-duty Cast Iron; (C) Dephosphorisation of Steel Castings and (d) Manufacture of Tin-free Bronzes.

Dr Malhotra is a Vice-President of Indian Institute of Metals and is Chairman of Rajputana Scientific Association. He is a member of Indian Railway Fuel Committee, of the Coal Conservation Committee of the Government of India, and Chairman of the Railway Foundry Advisory Committee of Indian Railway Conference Association. He is the President of Ajmer Merwara Refugee Coöperative Society at Ajmer, President of Rotary Club, Ajmer and President and Captain of Golf Club at Ajmer.



Dr RAJENDRA PRASAD
First President of the Republic of India

SCIENCE AND CULTURE

A Monthly Journal of Natural and Cultural Sciences

Vol. 15 FEBRUARY 1950 No. 8

The Republic of India

26th January, 1950

WE, THE PEOPLE OF INDIA, having solemnly resolved to constitute India into a SOVEREIGN DEMOCRATIC REPUBLIC and to secure to all its citizens:

JUSTICE, social, economic and political ;

LIBERTY of thought, expression, belief, faith and worship ;

EQUALITY of status and of opportunity; and to promote among them all

FRATERNITY assuring the dignity of the individual and the unity of the Nation ;

IN OUR CONSTITUENT ASSEMBLY DO HEREBY ADOPT, ENACT AND GIVE TO OURSELVES THIS CONSTITUTION.

PLANNING AGAIN

THE simultaneous release on January 19 from New Delhi of the text of a resolution adopted by the Congress Working Committee and of a communication reported to have been made by the Federation of the Indian Chambers of Commerce and Industry (FICCI) to the Government of India—both devoted through a strange coincidence to the vital question of planning—appears to be of more than usual significance• This is all the more so because exactly one week later the country was to have been declared a sovereign democratic republic with only such limitations on her sovereignty as are implicit in her membership of the Commonwealth of Nations and acceptance of the Crown as the *Symbol*

The Congress Working Committees resolution which strongly urges the Government to appoint a Planning Commission to help achieve the four fold objective of creating a just social order, increasing production ensuring the best utilization of resources and the maximum self sufficiency, embodies a new economic outlook rarely to be found in the past resolutions and pronouncements of this august body Equitable distribution ought to have been included probably this is implied in just social order Not only has the need for social and economic planning as an indispensable condition of successfully administering the affairs of the nation in the modern context of life been emphasized but the Governments responsibility in implementing this need speedily and quickly through the establishement of a statutory planning authority, the Planning Commission, has also been emphatically advocated The attempt to define the objects and purposes and to indicate the duties and functions of the Commission however inadequate reveals without doubt the Committees earnestness that the Government should do something about it before long and must not allow the economic conditions of the country desperate as they are to drift any longer Moreover, the Committee have seen fit to mention the new constitution as containing the germs of such a proposal for the creation of a statutory planning commission to carry out the objectives of the constitution

The Federations recommendations for the establishment of a central co ordinating authority to review the various plans of Central and Provincial Governments and to give these a strict order of priority closely resembles the Congress Working Committees proposal for a Planning Commission to determine priorities to work out a proper allocation and distribution of the resources and their constant adjustment to the changing requirements But while the Congress Working Committee have mixed up the question of planning with social and other broad issues, the FICCI, true to their profession have singled it out as a grave economic issue and fully substantiated it with a critical review of serious government failures in the economic field during the past two years Numerous examples have been cited and facts and figures quoted to show the failures in executing the plans hastily drawn up and decided upon The multi purpose irrigation and hydro electric power development schemes numbering about 170 have been the target of the most severe attack These schemes alone involved an estimated cost of Rs 1200 crores and required foreign currency specially dollar amounting to Rs 100 crores According to one announcement the Government intended to spend over Rs 200 crores a year on all Central and Provincial development plans This fact alone was a glaring instance of the lack of realism co ordination and appreciation of the countrys actual resources in capital materials and trained personnel which sadly characterized most of the Government planning Many of the schemes the Federation pointed out had not even come out of the exploratory stage The result was that quite a number of them had to be given up as unworkable after considerable sums of money were spent on them What was worse the Government often indulged in misleading optimism For instance in their report in 1946 the Advisory Planning Board appointed by the Government which strangely enough contained few or no members of the old Planning Committee but a number of hardened bureaucrats of the old régime had stated that during the next five years the provision of funds for the development is not likely to present much difficulties as shortage of capital equipment and trained personnel

The FICCI have not also spared the Governments open door fiscal policy in respect of the investment of foreign capital They have raised the understandable alarm that such a policy without proper safeguards and control might stultify the Indian enterprise

Mr A N Khosla in his presidential address before the Indian Institute of Engineers has also given expression to the increasing dissatisfaction with the chaotic condition of the Governments present planning policy

> In our impatience to cover in a few years the track of a century and with an overemphasis on our limitations in technical know how we are apt to sit back and look up to foreign aid That aid can be no substitute for self help What use will it be if foreign specialists and foreign capital are dumped in the country when we are not ready to make full use of them ? Foreign co operation is desirable even essential if we are to get away from narrow nationalism and strive for the common advance of mankind But we must seek this co operation on reciprocal basis and not in the form of benevolent dole to a nation out of work or unwilling to work It is for you engineers to show the way how self help can be integrated with international co operation with best results and without imparing national dignity or snapping national will
>
> We are still in the stage of transition from a police state to a development state There is need for rapid development but we have to regulate the pace to suit our limited resources in men money and materials We must utilize all available resources to the best advantage taking up essential things first and leaving non essential however desirable otherwise to wait for better times
>
> With a realistic and firm approach we shall achieve results If we disperse our resources and energy for any extraneous reasons our efforts will gather only liabilities in the form of half finished undertakings and result in shaking public confidence in our ability to produce results

> 'Realistic planning must, however, ensure that industrial development will proceed side by side with resource development. For instance, it will be wasteful to produce large blocks of power without at the same time setting up the industry or other load to utilize that power, or to provide irrigation facilities without at the same time preparing the agricultural lands to receive that water As stated in the Congress Working Committee's resolution projects for increasing irrigation facilities and power supply of the country are the basis of its prosperity and progress and will, therefore, rank first for priority
>
> It is necessary to have an inventory of resources and their periodical revaluation to keep them to date so as to find for instance, what is on top of or under the soil and what power potential can be developed in the rivers
>
> There is ample wealth in the country in the form of land water and minerals and above all the human materials There is, however, apparent shortage of money The problem is how to mobilize the effort for production and more production, to infuse into the general mass of people a sense of urgency in this respect and bring home to them the naked truth that unless we work and produce more our present low standards of living are going to deteriorate still further and we shall be heading for an economic crisis

It is difficult to disagree with the views expressed in the Federation's memorandum and in Mr Khosla's address Nor can we disagree with their main thesis that much of the country's present economic chaos is largely due to the Government's muddling in the name of planning But this diagnosis is by no means new It is perhaps not out of place to say that we, among a few other groups and individuals were the first to recognize and advocate the need for co ordinated State planning and to draw attention at the same time to the dangers of unco ordinated piece meal planning From before World War II when the economic outlook of the Congress could not get beyond the spinning jenny and the bullock cart, the industry and trade were openly sceptical about any move towards planning because of the implications of possible State intervention and control of production, and the then foreign Government regarded as idle, utopian and useless all talks of development, let alone planned development, we have been endeavouring to convince both the public and the Government about the urgency of national planning *

Historically, ideas of planning were first ventilated in this country by Sir M Visvesvaraya, the prominent industrialist, statesman and economic thinker between the years 1935 and 1940 and steadfastly thereafter through the useful pulbications of the All India Manufacturers' Organization, of which he was the president To the Congress belongs the credit of giving practical shape to Netaji Subhas Chandra Bose's idea of a National Planning Committee Appointed in 1938 under the chairmanship of Pandit Nehru, the National Planning Committee, although much of its findings are now obsolete and of little practical value, represented the first comprehensive effort at planning on a national scale The NPC worked through as many as twentynine sub committees which covered almost every aspect of the country's life Its work was interrupted by the incarceration of the Congress leaders at the outbreak of the war But even then within this short time, the NPC could collect and synthesize a vast mass of useful data and statistics which served as the most important source materials when, in 1944 and after, the industrialists of Bombay and, following their example, many other groups set upon themselves the task of preparing blue prints of economic development and thus producing printed solutions of the country's economic difficulties The individual merits of most of these plans, including the Bombay Plan, may be doubtful, but admittedly, these did much to popularize the idea of planning in this country as never before

The Department of Planning and Development (DPD) created about this time (1944) under the charge of late Sir Ardeshir Dalal, was the first official recognition of the State responsibility in planning But the Department made a false start by incorporating the idea of development along with planning which naturally enough scared the other departments and sowed the germs of discord and jealousy instead of one of co operation and co-ordination These departments of the Central Government and also the Provincial Governments themselves did not only obstruct the work of the DPD in various ways, but vied with the DPD and with one another in producing a spate of plans and blue prints In our editorial on ' Patterns of Planning in Different Countries", January 1947, we pointed out that, according to the most conservative estimate, the total number of pages covered by all these Government plans easily ran well over 20,000 pages This effort not only involved duplication, overlapping and confusion, but most of the plans were only sketchy and superficial compliation work by incompetent staff

In the face of these difficulties, the DPD, it must be admitted, did much useful work by appointing a series of industrial panels, whose findings and reports now constitute the basis of further constructive work in the important field of industrial development

After the transfer of power it was hoped that the Congress Government, with their well known sympathy for and interest in national planning, would take up the question of planning more seriously and on a permanent footing, and what was more important, would restrict the preparation of, and the practice of taking decisions on, departmental planning It was a pity that nothing of this sort was done On the contrary, the same mistake was repeated by encouraging the appointment of an endless series of committees and sub-committees separately responsible to the various Ministries of the Central and the Provincial Governments, resulting in the economic chaos and confusion to which the FICCI have now referred

All this was foreseen by those who had some knowledge of this planning business in India In our editorial

---

*The following is a selected list of editorials on planning appearing in SCIENCE & CULTURE
Planned Economy for Provinces August 1939
PEP -its Aims and Objects March 1942
Planning and Prospect – May, 1944
Department of Planning & Development—July, 1944
Planning and Policy—December, 1944
Planning and Muddling—December 1945
Patterns of Planning in Different Countries– January 1947
National Research Council—October 1947

referred to before we strongly criticized the practice of unco-ordinated departmental planning and proposed the setting up of a Central Planning Commission vested with proper authority as an integral part of the Government The Planning Commission we suggested should be a fact finding body continuously studying and investigating the condition in every department of human activity all over the country collecting and maintaining up to date statistics in agriculture industry health education communication and defence and other activities A Central Statistical Department was considered an essential part of the planning machinery The Chairman of the Planning Commission was to be a whole time man a member of the cabinet and one of the vice presidents of the cabinet

Later on in the October 1947 issue of SCIENCE & CULTURE we came back to the same subject and elaborated the machinery of a Central Planning Commission and its relationship with other ministries The duties and functions proposed for the Commission curiously enough agree very closely with those now specified in the Congress Working Committee s resolution In one respect however there is a very important difference The Congress resolution states that one of the duties of the Planning Commission will be to secure full and all round co ordination in the progress of planning and in the execution of the plan We find it difficult to agree with the idea of including in the duties of the Planning Commission any aspect of execution of the plan which should exclusively concern the other ministries While it should and must be fully within the competence of the Commission to study the stages of development of the plan and the difficulties and failures which are likely to be experienced in the progress of execution and to make recommendations for future guidance the Planning Commission should not have any responsibility in the matter of execution or co ordination of execution of the plan itself As pointed out before this was precisely one of the main causes of failure of the old Department of Planning and Development Our conception of the Planning Commission as we have often expressed in the columns of this journal is that its functions should be similar to those of an architect of a building and not to those of the building contractor The task of finding out whether the execution has fulfilled the plan should of course devolve on the Commission

There is yet another important aspect to which sufficient attention has not been paid namely the role of scientists engineers and other experts in the Planning Commission The Commission have doubtless to be guided by the over all political and social philosophy which the Parliament will choose to set before the country but its functional success will primarily depend upon the extent of its expert and scientific composition The expert composition of the Commission can alone guarantee an objective approach to the country s economic and other problems and their solutions to be worked out in the plans This consideration led us to suggest in our editorial of the October 1947 issue the establishment of a National Research Council along with other councils for labour finance etc as functional organism of the Planning Commission We saw this as an effective way of intergrating science with national planning

Since that article was written the Government have step by step created new organizations which when properly co ordinated and allowed to function actively under will materially advance the work of the Planning Commission In June 1948 a Department of Scientific Research under the Prime Minister was established whose function *inter alia* would be to tender scientific advice to the Government deal with ad hoc scientific research co ordinate the scientific activities of other Ministries For this purpose a Co ordination Committee consisting of eminent scientists has been established We had occasion to review the functions of this new Department (September 1948) and to suggest that it should be converted into a Central Scientific Office of Cabinet level similar to that proposed for Great Britain for the co ordination of national scientific policy with the economic policy of the Government to be linked up with other planning agencies in the Cabinet Offices and with the Central Statistical Office when created A Central Statistical Organization under the charge of the Statistical Adviser to the Cabinet was started in January 1949 A permanent Office for Census and Vital Statistics under a Registrar General was established in May 1949 All these organizations according to Prof Mahalanobis indicate a move towards a more comprehensive review of the economic policy of the Government The role of statistics in National Planning has been described by him in his presidential address before the Poona session of the Indian Science Congress as follows

> National planning has several aspects First there is the preparation of plans at the technical level requiring the help and co operation of workers in every branch of science and technology Statistics is indispensible at this stage for the supply of basic information Secondly the individual plans have to be built into a general plan Here statistics is the common denominator and supplies the common binding medium for the whole Thirdly the plan has to be implemented At this stage also statistics can help in two ways Firstly by establishing scientific contr nes to ensure the programme of action proceeding on efficienol lines Secondly by conducting continuous assessments of the results, by keeping account of the input of money effort and resources and measuring what is obtained in return The process is enivor ending In the actual working of the plan defects are revealed and new possibilities emerge requiring consequential changes Statistics is again invaluable in diagnosing weaknesses in guiding controlled experiments and in suggesting improvements. Statistics is thus an integral part of the dynamics of nation planning

He concluded his very important address with the following words

> In a national plan scientists and technologists also have to make their contributions They can give the labour of their thought and by the skill of their research and experimentation show how to overcome difficulties and open out new possibilities The statisticians have a humble rôle but they also can help in reaching vital decisions

The utter inadequacy of making assessments and framing recommendations by individual committees in the absence of a permanently functioning Planning

Commission, is clearly exemplified by the report of the Scientific Man Power Committee which has just been released to the public We have nothing but admiration for those who are responsible for the report They have spared no effort to form an estimate The Committee have estimated that during the next five years the Government s total need for scientific personnel of both senior and junior grade would be about 3 12 000 Against this only 35,300 scientists and technicians of *all descriptions are at present employed in all the Government* and Government sponsored departments That is, within the next five years the Government will absorb ten times as many scientists and technicians as they do now We wish that this really happens But do the recent trends of employment of scientists in Government services or in industries justify this optimism ? Have the financial implications been carefully worked out ? If we assume, on an average an emolument of Rs 200 per scientist inclusive of all allowances which is an extremely economic estimate under the present living conditions this means an increase in the budget by over Rs 70 crores a year for salaries alone But the scientists and technicians can not work in vacuum They would require secretarial and unskilled staff and further scientific equipment, tools, chemicals etc of both capital and recurring nature, which would be an item of no less heavy recurring expenditure The Scientific Man Power Committee have not examined this aspect of the question whether the Government revenue would during the next five years increase by such an extent as to make possible the absorption of scientific personnel on this scale We know there is already unemployment among scientists and technicians and the plight of science graduates and masters of science is daily becoming worse at least in this part of the country

The Committee have admitted their unavoidable dependance on existing Government blue prints of development Calculations and estimates had therefore to be made on the basis of what the over enthusiastic Government departments proposed to do in the near future in order to achieve *Ramrajya* overnight and not on the basis of what they were actually capable of doing under the existing limitations of financial and material resources The result was another unfortunate instance of waste of money time and energy and the birth of an abortive report which leads the country nowhere

In his presidential address Prof P C Mahalanobis referred also to the Government's drive in attaining self sufficiency in food by 1951 and showed how official optimism was hardly substantiated by the available statistical evidence When one takes into consideration increasing pressure in population, the critical balance between food and population, increasing food imports during the last ten years inadequacy of food and agricultural statistics, the Government's emphatic declaration of the policy of attaining self sufficiency in food by 1951 however commendable, represents hardly anything more than a pious wish The various constructive suggestions which Prof Mahalanobis hinted in course of his address can only be translated into practical propositions by a National Planning Commission

> It is certainly necessary he said to attain self sufficiency in food by 1951 But this is not enough The production of food must keep pace with the growth of population But not only food it is also necessary to produce houses clothes and thousands of other things in increasing quantities Production must keep pace with population The future trend of population in India is therefore a matter for serious concern Available evidence indicates that at the existing level of production the balance has already become adverse *A* further and continual growth of population without a commensurate growth in the means of production will be disastrous The only way is to develop our national resources

The country *today finds herself* in a perilous economic condition Precious time has been lost through failure to appreciate the real issues for lack of experience and consequently through inaction and indecision Things must not be allowed to dirft any longer The Government should immediately set up the Planning Commission not for the employment of the unemployed in high Congress ranks, but for making available to the Government the counsel of such men who by their upbringing and labour, are capable of taking stock of the entire situation and starting on a clean slate If it involves the temporary postponement of all development plans for a year or two, it will still be well worth putting up with the temporary inconvenience and hardship that such postponement might entail The prospect of a better, surer and all round productive endeavour will be infinitely more welcome than the present chaos, uncertainty and aimless groping in the darkness

SPECULATIVE PHILOSOPHY OR PROGRESS*

ARTHUR F MORGAN

EXCEPT for the most primitive of aborigines men are not content to live in the world as they find it They undertake to make over the corner of it in which they live so that it will suit their needs Only the most primitive people rely so much on the natural world that they depend for food on the wild fruits and nuts which nature provides They make over their own part by clearing the forest and cultivating the land In some climates they do not depend on natural rain for their crops but store water for dry weather irrigation In many ways men make over the natural world to suit their needs

Many other animals control nature and make over their environment in limited ways Beavers construct dams to create small lakes in which to build their homes Birds and many insects build nests and many animals dig holes in the earth for shelters Nearly all such abilities are specialized inherited traits In man on the contrary efforts to control nature and to remake his environment cover nearly every phase of his life and take numberless forms

Without such mastery of nature the earth would support but a small part of its present human population In the part of North America now occupied by the United States before settlement from Europe began the half million aborigines who occupied that great area were often near starvation because of exhaustion of their natural hunting grounds For their way of living in the world as they found it the land was over crowded Bloody wars of extermination were fought for possession of hunting grounds Today with greatly increased control of nature the same land supports not half a million but one hundred and fifty million people and this hundred and fifty million live on a so much better scale that the poor pauper on relief has a higher level of living and greater economic security than the favoured tribal chief of the old days

As control over nature increases men gain increasing security against flood drouth famine and disease and great as have been the gains of men in the past by such controls the vast possibilities for increasing mastery of nature are barely touched The security won by that increasing mastery may be of little value unless there is corresponding development of ethical and spiritual qualities There is no one kind of excellence which by itself will make a good life for individuals or for society A well proportioned development of all phases of life is necessary If any one vital element is seriously disregarded the whole pattern of life may be greatly reduced in quality Mastery of nature is not the only condition necessary for a life of dignity and security Yet it is an essential element and disregard for such mastery will result in poverty disease and degradation

Man should be a harmonious part of the community of nature When the term mastery of nature is used it does not imply that something outside of nature imposes dominance upon it Rather the expression is used in the way in which we would speak of self mastery, which does not imply that one part of self dominates over other parts but that the growing personality achieves integration and fulfilment

With some people while any long established control of nature such as cultivation of the soil or the building of houses is accepted almost as a part of nature like the building of nests by birds any recently achieved control seems unnatural and artificial This difference is in the attitudes of the persons concerned and not in the processes themselves

At every step in the history of mankind increase of mastery of nature has been brought about by three essential elements First there is required direct intimate first hand acquaintance with those elements of nature that are to be mastered We seldom can either understand or control that with which we are not acquainted Simple and obvious as this statement seems failure to realize it has been one of the chief causes of human backwardness

The second necessary element is understanding Only as there is capacity and desire to understand to see what has meaning and why and to see how things are related to each other can increasing control of nature be brought about Understanding is gradually developed in society and is passed of from generation to generation Only that intelligence which is supported by accumulated social wisdom is adequate for the mastery of nature That is, wide ranging education either formal or informal is essential to the most effective and progressive mastery Third increase of mastery of nature requires skill of hand and eye Every step in the actual work of making the world over according to our need involves such skill Whether one is digging an irrigation ditch or is carrying through the most complex and exacting physical or chemical experiment skill of hand and eye in handling and dealing with physical things is a primary necessity The most brilliant and penetrating theory is without effect in controlling the environment and in remaking our world until appropriate skill of hand and eye have done their part

Understanding and familiarity with the physical world where acting by themselves produce the scientist Skill of hand and eye and familiarity with tools and with the phases of the physical world being dealt with produce the craftsman or technician

Finally these various activities are most effective for making desirable changes in our environment when they are associated with each other Just as men do not cooperate most efficiently if they are strangers but only when they have intimately acquainted and have learned to work in unison so brain and hand do not cooperate effectively if they are nearly strangers Cooperation is best when they have developed such habitual coordination as that of the hands and mind of a master of music who expresses his mind and soul as he plays a musical instrument with his hands Such coordination of mind eye and hand as a rule results only from a lifetime of the practice of coordination

---

*Based on a talk given at the Indian Institute of Culture Bangalore March 1949

Now if there are any deep seated attitudes which tend to prevent the development of understanding or of acquaintance with nature or of skill of hand and eye or which interfere with the coordination of these three so that they cannot work together effectively then such attitudes may become great handicaps to the increasing mastery of nature which is one of the primary essentials to human well being

I am of the opinion that in nearly all civilized countries certain attitudes have prevailed which have interfered with the growing mastery of nature In some countries such interference has been greater than in others

In ancient days India was in the forefront of humanity in the control of circumstance and in the process of making over the physical environment to meet men's needs Then for some reasons that habit of increasing mastery was largely discontinued As evidence of the interruption of the habit of mastery we may point to the facts that except where European methods have been adopted agriculture uses the same tools and technic as at the dawn of history thousands of years ago Except for recent western innovations mechanical devices are about the same as then and engineering methods have not greatly changed A hundred times as much human time and effort are required to pump water by methods indigenous to India as by modern western methods The average span of life is shorter in India than in any other great civilized country and the standard of living is lower Disease is more general Judged by various standards India has not maintained that quality of achievement of which her ancient life gave promise In view of ancient achievements and of the generally high level of Indian intelligence there seems to be no genetic reason or anything inherent in the environment which made this slowing down of progress inevitable India had achieved a high level of civilization while most Europeans were still crude primitives dressed in skins

All the potential wealth of India has been present during these thousands of years There was adequate intelligence The Sanskrit language among the most discriminating in the world must have been developed by very high intelligence The Vedic writings show penetrating thought The water power has been there wasting itself through the centuries The coal iron ore and aluminum bearing bauxite have been in the hills Plants and animals have been inviting men to improve quality by selective breeding Dry but fertile lands have been awaiting irrigation Disease, poverty and mental and social maladjustment have been displaying their nature and have been calling for study, understanding and mastery

Until two or three hundred years ago Europe was largely in the same retarded condition as India The sudden development of control of nature which has taken place has not resulted from anything new being added to the earth or to any sudden increase in the mental ability of men but from liberation from certain bondage of mind and spirit which had made men largely impotent Even today that liberation of the western mind has only begun Can we discover anything in the Indian attitude toward life which might account for the long time thwarting of that control of the environment for which all the necessary elements seem to have been present ? There are two attitudes which in my opinion have interfered seriously with that increasing mastery of nature Neither of these is peculiar to India though both are present here One of these is the caste system and the other is the common philosophic attitude of retreat from objective reality Curiously these two attitudes have somewhat the same adverse effect on man's mastery of his environment Because the caste system can be disposed of more briefly I shall touch on that first

Europe also has had its caste system but perhaps because European society of one or two thousand years ago was cruder and less definitely organized caste was not so well developed nor so thoroughly enforced It has been characteristic of the caste system in India that men of different castes become competent and skilled in their own fields but seldom achieve familiarity and mastery of the work of the other castes Because some castes provided the philosophers and reflective thinkers while others developed skill of hand and eye in craftsmanship while perhaps still others provided skill in administration and management there tended to be a lack of that union of reflection and of execution and of union of mind and hand with intimate acquaintance with materials which are necessary to advance our control over nature The man of scholarship and reflective thinking lacked intimate acquaintance with the physical world On the other hand both the administrator and the skilled craftsman lacked much of the intellectual cultural inheritance and of the philosophic outlook Thus because under the caste system intellectual development and reflective thought tended to be divorced from practical management and from craftsmanship the person of reflective thought did not have the necessary practical skill to remake his environment while the practical manager and the skilled craftsman did not inherit the tradition of ranging mind and philosophic reflection which produce mental pictures of the new world men need to fulfil their possibilities

I repeat this is not purely an Indian problem For a thousand years medieval Europe also had its caste system But for that fact and for the philosophic retreat from reality the present age of growing mastery of nature might have dawned on both Europe and India two thousand years ago

The other attitude we have pointed to— the philosophers flight from objective reality—has tended to a similar result It is desirable again to emphasize that the kind of mastery which controls the physical environment and makes over the natural world to suit man s purpose definitely requires both intimate first hand acquaintance with the elements to be mastered and the disciplined and practical skill of eye and hand which makes possible effective manipulation of tools and materials Every step in the actual control of man s environment has called for such intimate acquaintance and for such skill with physical things

Now it is a usual characteristic of the philosopher that his attention is directed not to the objective world about him but inward upon his own thoughts and mental processes When the philosopher reads it is commonly the writings of other men whose thoughts were similarly directed

Because the philosopher s mind is turned inward he like the high caste men we have just described is generally unskilled and inept in handling physical things With doubtless many individual exceptions such as Spinoza the spectacle maker this has been characteristic of philosophers from time immemorial until recently Simple and incidental as that fact may seem its natural and almost necessary results are far reaching and momentous on the one hand to philosophy and on the other hand to man s degree of control of his physical environment

Scarcely any course of action which could be devised short of solitary confinement in an empty cell would so conduce to ineptitude in contact with objective reality as does that of the philosopher in turning his mind away from the phenomenal world and of centering his attention on the world of abstract ideas And here is a significant result The philosopher s personal helplessness before objective nature almost inevitably reacts on the philosophers outlook In his mind the helplessness before the objective world which he experiences in himself comes to be one of the given facts of life even more basic than Descartes dictum I think therefore I am This helplessness seems so completely obvious that it seldom comes into question in philosophical discussion and seems to require no argument To question that helplessness in any but small matters seems fantasy

Now there is an impulse in man as in every living thing to achieve completion of an ideal pattern[*] For instance every tree that grows has such an impulse to realize an ideal Every twig and every leaf which it produces is in response to that impulse to perfection Such impulse never has full expression because perfect fulfilment is sure to be more or less prevented by adverse circumstance and perhaps by inner conflict or incongruity within the pattern Man as an animal shares with all plant and animal life this impulse to fulfil an ideal type So far as his physical body is concerned he is like plants and other animals in that he has little choice as to what that bodily pattern will be His physical type is substantially determined before his birth and which of you by taking thought can add one cubit to his stature ?

But man has qualities of mind and spirit which are scarcely if at all evident on lower animals His mind or spirit also has cravings to fulfil ideal patterns and these patterns of mind and spirit are not dictated to him before birth as is the ideal pattern for his body To some degree he seems to be free to create his own ideal patterns in his mind or spirit

The apparent existence of ideal patterns which bring species try to exemplify suggests that behind the objective phenomena is reality which cannot be realised or known through the senses This discussion does not deny that assumption but holds that the first method we have for getting intimation of such reality is reflection disciplined by observation of objective reality

This freedom to create or by exploration and comparison to select one s own ideal pattern of mind and spirit is far from complete A man s range of choice is partly limited by his biological inheritance There are elements of compulsion in social tradition in governmental requirements in religious indoctrination in economic circumstance and in the prevailing mores Yet to some degree it seems that the individual may make creative contribution to his own ideal pattern By observation and reflective thinking he can give consideration to logical relationships of cause and effect Sometimes bursts of creative intuition or insight make their contributions

Possible ideal patterns of the mind or spirit range from small to great and from the most self centred ambition to patterns aiming at the long time good of all that lives Sometimes such ideal patterns of mind or spirit relate chiefly to the physical world A man may picture himself as possessor of a beautiful garden and then he may strive to realize that picture Another has a vision of a successful business career Another pictures an empire with himself as emperor and spends his life for the achievement of that vision Hitler envisioned a vast State in which the ideal pattern he had formed could be imposed upon all men The democratic mind envisions a society in which every man shall be free to determine his own ideal pattern as long as it is within the framework of the general good Spiritual leaders arise and present ideal patterns which they would share with all mankind and sometimes the followers of such a leader claiming that the pattern they follow is the one true ideal give it rigid doctrinal form and desire to influence or compel all men to accept it as their own

The ideal pictures in men s minds to the fulfilment of which they commit their life efforts vary greatly in social value Some of these ideal pictures call for influencing the motives of men towards peace on earth and goodwill toward man Some are concerned with personal satisfaction or aggrandizement often regardless of the effect on the lives of other men Dictators, exploiters and selfseekers of many kinds develop such mental pictures and try to fulfil them Some men have ideal pictures of increasing man s power over nature of subduing the earth and of making it over so that it will be more suitable for fulfilling human need

---

[*] Such terms as "ideal pattern and ideal type are not intended to imply a pre existent Platonic idea of which the actual is a reflection nor to infer any other explanation of the phenomenon referred to but only to identify it by a convenient name

The desire to increase mastery over nature is not only a kind of ideal picture which some men have for its own sake but it is also a means to other ends The man of selfish ambition in his desire to be dominant over others may try to build a bigger palace or to erect a greater monument and so is involved in mastery of nature A man of strong social purpose may desire to reduce human tragedy by stopping floods by overcoming drouth by removng conditions which cause disease and he also needs increased control over nature

Not only is the philosopher ill equipped for the mastery of nature whether his motives may be the service of his fellow men or the winning of a great name among philosophers but because his attention has been turned toward abstract ideas rather than toward physical realities he is not greatly interested in such mastery Being himself relatively helpless before nature he generalizes his own helplessness as a universal and inevitable helplessness of man before the natural world That helplessness becomes an inherent part of his philosophy

One observes the widest possible range of motives to which power to master nature and to control events is made the instrument In a hundred research stations men are breedng new varieties of crops to increase the human food supply In a hundred laboratories men are seeking the cause and cure of disease On the other hand vast sums are being spent to make men able to kill each other more effectively The invention of paper and the printing press is typical These added controls of nature enable men to more effectively publish truth or falsehood about each other Control of nature is welcomed because of faith in man faith that in the long run the spirit of man will use his powers for his good

It is a characteristic of men that they do not easily accept defeat As they find fulfilment impossible in one direction they turn to another The philosopher helpless before the vast tyranny of the physical world turns to the world of speculative ideas Unable to drive a nail or to plant a field he comes to have his interests and to make his home in the world of his speculations In that other world actualities do not enter to mar his ideal structure The more his ideal structure is beyond test by the senses the more immune it is to injury and the more he feels securely at home there Compared to the vast sweep of his mind how trivial and mean are the efforts of men to drain a swamp to build a house even to assemble an empire Craving a sense of reality and validity for the world of ideas he has created he comes to view his world of speculation which cannot be tested by the senses as the world of reality while the physical world around him he calls illusion Has he not in effect found escape from reality ? Is not this flight from reality the great sin of philosophy against mankind ? There is no necessary purity or refinement in escape from objectivity A philosopher may carry over into the realm of abstract ideas the arrogant positiveness of a dominant caste Purity of spirit may therefore be more commonly found among the lowly than among those who flee from the objective world to that of abstract speculation

Without the humbling discipline which comes from relating one's thinking to objective reality the philosopher may become arbitrary irresponsible and capricious The philosopher who lives in a world of speculative abstractions must also live in the phenomenal world Since the two worlds are often incongruous, the habit develops of living with and accepting incongruity as natural To carry truth and falsehood together comes to be called tolerance Incompatibles come to live together in his mind creating inherent disharmony a condition not favourable to development of a great integrity of spirit or a great ethics

Even when speculative philosophy calls men to action unless there is a live belief in the possibility of remaking the world to serve the needs of life the action called for may be only a short of ceremonial a sacrament required by the gods rather than a process of remaking the environment Only out of faith in the value of purposeful action can it become effective or ennobled

As the philosopher's influence spreads the attitude tends to prevail in society that the world of speculation of patterns and theories beyond the test of physical experience is important while the physical world is relatively unimportant Is not India thoroughly saturated with that belief and is not the western world only gradually liberating itself from a similar state? When men come to give first allegiance to a world of speculation which is beyond objective examination the increasing mastery of the objective world the progressive remaking of man's environment to suit his needs slows down or stops The latent mental spiritual and physical capacities for mastering the physical world are still present in men but belief in the possibility of such mastery and the spirit to undertake it are gone Whenever speculative philosophy in its flight from objective reality becomes dominant then man's mastery of his physical world declines

Such a decline in the habit of mastering nature and controlling the environment has taken place here in India Here where this product of speculative philosophy has been fixed in the minds of the people as perhaps nowhere else on earth and over a long period and where more than anywhere else a purely speculative view of life is held to be superior to a mastery of the objective world what do we find as to man's relation to nature As I have said before the tools men use for living in India are more primitive and less productive than in any other civilized country A day of a man's life in labor will produce less of the physical goods men live by than in any other civilized country The life span is shorter than in any other such country Poverty is more general and more extreme Disease is more prevalent

Fifty thousand men from a country half way around the world, which did not despise mastery of nature, for centuries held in subjection a population of hundreds of millions. Servitude of spirit was ingrained in a great people.

Because the intellectual leadership of India concerned itself with speculative philosophy which did not concern itself seriously with remaking the world, the man of action was not provided with a great pattern for his life. Following the conventional pattern of men of action he became a great military conqueror. With great power to control circumstances he built himself a kingdom, built it on human blood, or by the servitude of many men built himself a palace which cut him off from the common life. If the concern of thinking men had been the mastery of nature for the benefit of the common life, then a great ideal pattern of action would have existed to call the loyalty of men of action. If we ignore esoteric criteria so private that they cannot be communicated to others, the fruits of speculative philosophy have not been glorious.

The philosopher makes vast generalizations which in his mind describe the underlying nature of things and include all the world. For instance, there is the concept of "evil" as an inherent element in the nature of the world. Before such a universal as "evil", man seems hopeless. What can he do against the very nature of existence? Yet, in fact the abstract idea of "evil" is a philosophic creation.

Suppose, now, that instead of being a speculative philosopher dealing with vast speculative generalizations, such as "evil" the man of insight is a practical person, seeing what he actually sees. What he actually has experience with is not the abstract generalization "evil", but certain specific evils. Concerning some of these he may not be entirely helpless. One evil he observes is starvation. He can turn his attention to better varieties of crops, better methods of cultivation, more certain water supply. Perhaps there is over population. He may study population balance and develop elements of population policy. Disease is rampant. He can study the causes of classes of diseases and of particular diseases, and the nature of the human body that is subject to disease and little by little may master disease.

Such an approach to life has spiritual quality. At the Buddhist temple at Sarnath there are murals depicting incidents in the life of Buddha. One of these pictures the master bathing the body of a man ill with dysentery. Today, nearly 2500 years later dysentery is probably as prevalent in India as when Buddha performed this act of mercy and brotherhood. Would there have been any less a spiritual tradition if through the years a band of devoted men had studied the nature and causes of dysentery so that it might be eliminated from the world. In some large areas of the western world dysentery has been almost eliminated by men who did not speculate on the concept of evil, but did study the nature of dysentery.

Think of the great university of Nalanda, lasting through nearly a millenium with 8000 to 10,000 students. What if, instead of speculative philosophy, dealing largely with subject beyond experimental inquiry, these students and their teachers had been engaged in learning how to master physical circumstance and to remake men's environment!

If we should excape from the concept of the helplessness of man in the objective world and should bend our energies on the mastery of nature, what fields might be covered and what gains might we expect!

Suppose we try to picture what might have happened through the centuries if the remarkable minds which gave form and content to Indian speculative philosophy had instead seen the hope of mankind as to be achieved through the mastery of phenomenal circumstance and the rebuilding of the world about us. Let us include in the world which is subject to rebuilding not only wood and stone, but also the make up of man and society, so far as that remaking is possible within the range of human skill. Thus we may include social policy, economic policy, medical practice, psychiatry, population policy and eugenics as well as more obvious fields such as biology, chemistry, physics, engineering, forestry and agriculture.

As a first requirement for rebuilding our physical world there is needed the objective, critical mind. One of the greatest needs of humanity is, not to be taught by authority what is good, beautiful and true, but to be encouraged to inquire. *Teaching by authority puts the mind to sleep.* The process of inquiry keeps it awake. The great teachers of the past may have felt that the truths they had won were so precious, and the minds to whom they would transmit them were so immature, that only by authoritative teaching could the great message be preserved. That attitude might be called the original great mistake of the teacher, since it set up a process that is inherently deadening to the spirit of inquiry. Had the attitude of mutual inquiry been nurtured, then those who were taught would in time surpass their teachers. A renewing and creative process would be under way. Nothing would be so sacred as to be immune from that process.

In the field of man's protection from physical catastrophe, the last few centuries in the western world have made great headway. Many sources of physical catastrophe can be removed, and others can be made increasingly harmless. Earthquakes cannot be prevented but we can know just where they are likely to occur, and can largely prevent damage by them. The ocean hurricane cannot be stopped, but it can be foretold and avoided. On the whole in technically advanced countries physical catastrophe is coming to be one of the minor sources of human tragedy, and every year the range of possibility for removing such danger is greater.

Throughout human history the greatest source of tragedy, aside from Man's inhumanity to man, has been economic need. Today hunger and poverty are no longer beyond technical control. The most thickly settled regions on earth could have food in abundance from their own production if the most effective methods we know were generally in use. This is true even though our knowledge of soil, climate and crops is in its infancy. The technical possibilities of feeding the world will probably always run far ahead of the increase of population Most professional estimates of possible food production assume production by methods that are far short of the best we know

Population policy with limitations of population density are necessary but for hygienic aesthetic cultural and spiritual rather than for economic reasons Men live best with adequate space and freedom of movement Too dense population tends to lower the quality of life Overcrowding and its results may be a source of human tragedy Here too critical research may replace blind dogma and vague impression with sound population policy and so may decrease or remove a source of tragedy

Disease also has been a vast source of tragedy More progress in the cure and prevention of disease has been made in the past century than in all preceding history and progress was never more rapid than now Had critical inquiry in this field been active for the past two thousand years it is probable that tragedy from disease would now be rare

Mental disease as well as physical so much on the increase in our uncoordinated modern life is subject to understanding and control and prevention Although knowledge of mental health is in its infancy it seems reasonable to look forward to a time when the tragedy of mental ill health will be a rarity

Partly the freedom we forsee from mental as well as physical frustration and tragedy will come from the study and practice of eugenics Through the coming years eugenic research education and policy may lead to rapid and sustained improvement of human quality and tragedy from inadequacy of human inheritance may largely disappear

Among the chief sources of human tragedy have been the false traditions myths dogmas and beliefs with which men have been burdened Here too free inquiry and penetrating search along with intelligent education can remove a great burden

And so in the fields of social economic and political organization if we withdraw our attention from evil as a philosophical abstraction and center it upon some particular evils we can help to remove or on some particular promises of human fulfilment we can hope to achieve the whole color and flavor of life may change

In this process of mastering the problems of life item by item through disciplined observation reflective thinking on what we have observed skill of eye and of hand in doing what needs to be done and experienced skill of administration in bringing about necessary changes will men sometime come to a stone wall which will prevent any further progress ? Perhaps there is no impassable wall Perhaps as we do the best we can with this process of mastery the way will always open ahead, for the process of mastery is the process of finding or of making a way

The speculative mind may say, 'But suppose man achieves all you have dreamed Suppose you eliminate most of the natural catastrophies and conflicts, drought and famine, suppose you do all that, And suppose also through your psychologists doctors and your good education you get rid of superstition and mythology get rid of the warps and twists of mind suppose you do all that and clear away all those specific evils What has been gained in the end ? For without doubt our planet itself will cease to sustain life

Think how slight was the power man had over his world a brief two hundred years ago ! If someone had said The time will come when men will fly half way around the world would he not have been considered a freak ? It is only about twenty years ago that I talked with some of the ablest scientists of America as to the possibility of men ever using atomic energy One of them said It is thought about, but the conditions are so fundamentally against it that it is probably only a dream It probably can never happen that we will get the energy of the atom It is probably one of the ultimate impossibilities

Recently I read a considerable number of world famous utopias and observed the wild flights of fancy of the authors as they pictured the wonderful achievements of man in the ages to come It is interesting that as to nearly every one of these fanciful forecasts the real achievements of men have far outstripped these wild fancies of a few decades or a few centuries ago So in regard to the ultimate destiny of man, we are unsafe in putting limits upon it If we can take hold of the work before us the disease the poverty the waste land that can support more people if we can affect the causes of strife if we can turn our attention to see not evil as a universal abstraction, but specific evils which we can have some part in removing if we push back the barriers of life and enlarge the range of human possibilities our efforts may have enduring value The disregard of the physical world men have had is in error We need not have less of spiritual life but it can find expression in mastery of our world rather than in flight from its problems By mastery of our world I repeat is not meant dominance of one part over another but integration of growing human purpose with the objective world of which we may be harmonious elements in the community of nature

Perhaps there is no predetermined road that man must travel Perhaps the possible courses which life can take are endless, and perhaps we can have a part in deciding which way we shall take It is left to us to explore and inquire as to which ways are more excellent and what less excellent We should use the service of science We need to get over the idea that science deals only with facts while philosophy and religion deal with values Science must deal with values For instance take our codes of ethics and examine them Such examination might take us into chemistry biology, psychology, economics and sociology We would do well to know what are the actual effects of various elements of conduct The world is full of obsolete moralities, hold on authority Suppose we begin to look at these, examine them as to how they actually affect human life In a world of growing understanding and purpose ethical standards also must grow or disaster may follow as is threatened now by obsolete standards of nation sovereignty which means national irresponsibility They are obsolete both because of the mistaken or obsolete standards they contain and because of standards vital to the well being of life which they omit

Both the western world and the India world have looked upon the weight and burden of life as something beyond our control According to that view we can alleviate it for each other here and there in a spirit of love and brotherhood like the Buddha washing the man with dysentery but in the total we were helpless before physical fate We need a new kind of faith the faith that man can master his physical world If we can have that faith then spritual quality can find motivation Each day s work of every man be his ability small or great can be adding to the quality of life He will not be living in a vale of tears for which the best hope is escape He will be engaged in a promising adventure with possibility of unending increase in value The concept of progress is not an illusion

This spirit it seems to me was inherent in Gandhi s teaching He had spiritual quality but he applied it to the practical problems next to him in his own way He was trying to make physical facts correspond to his judgement of what would be a good life This is not to say that he had entirely escaped from living in a world of speculative philosophy but he had gone far in that escape Perhaps the powerful hold which Gandhi had on the common people of India was due to their intuition that here was a man who to a considerable degree had centered his attention on the phenomenal world and was determined to improve it

Mankind is on a great adventure in a world of objective reality Perhaps it is a real adventure Perhaps there are risks of failure We do not know the time clock of the world Perhaps the time available for mastery is not unlimited Perhaps how you and I live will make a substantial difference to the outcome Perhaps the time we have spent in building speculative fantasies that are beyond the range of objective inquiry perhaps this is waste of precious time Does not the world of objective nature call us to responsibilities as well as to opportunities

---

OIL PROSPECTING IN THE TIRU HILLS AREA, UPPER ASSAM

J COATES

BURMAH OIL CO (I C) LTD NEW DELHI

READERS of SCIENCE & CULTURE may have noticed the newspaper reports of the drilling and abandonment of an oil test well at Tiru Hills near Jorhat in Upper Assam Some additional technical notes may be of interest to indicate the nature of the results obtained and their significance

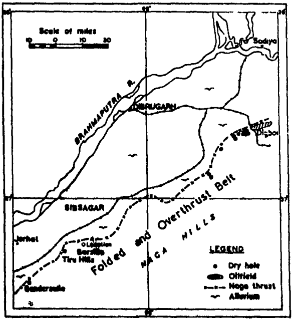


Fig 1 Map showing position of Tiru Hills Test well (after Coates)

The Tiru Hills area had been known for some time as one of the possible oil bearing structures of the Upper Assam region but it was not one of the most apparently attractive as it is of relatively small size and not so closely connected as some other areas with evidence of the existence of oil It therefore waited its turn while other more attractive areas were investigated first and only when those had one after another been proved valueless did Tiru Hills come into consideration for actual drilling At one time it was felt that the failure of the Bandersulia test well (which is structurally fairly closely related) extinguished any hopes at Tiru Hills but later opinion was that one could not be quite certain without an individual test here

The favourable aspects of Tiru Hills area as revealed by the regional mapping were that (i) it is an anticlinal structure with an intact crest and (ii) oil-shows occur regionally and are known at the surface not many miles away in rocks which are below ground at Tiru Hills In expansion of the first point, it may be explained that in most of the anticlines in Upper Assam (including the Digboi oilfield) there is a thrust fault running along one edge of the structure, and this fault cuts across the anticlinal crest at a depth that depends (in part) on the extent to which erosion has lowered the surface It has been found that the prospects of any of these areas depend upon the preservation of the anticlinal crest, and therefore Tiru Hills, which has quite a broad belt at the surface between the crest and the thrust fault, was favourable in this respect, Before direct plans could be made for drilling the area had, of course, to receive a more detailed examination so that the location could be chosen and depth estimates made One of the essential points was to fix the position of the thrust-fault which is hidden under the alluvium although known generally to run along the length of the structure To this end geophysical (gravity) traverses were made and 13 shallow core holes put down along certain lines to determine the position of the fault and its hade near the surface Detailed geological mapping was also carried out aided by an aerial photographic survey on the exposed rocks of the area—although actually they are so poorly exposed owing to the thick forest cover and deep weathering that dip evidence had to be obtained almost entirely from pits dug for that purpose

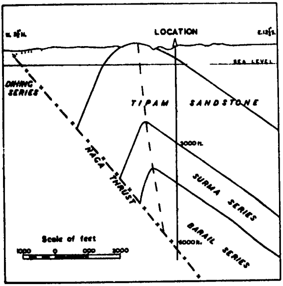


Fig 2 Transverse section through the location Tiru Hills (after Coates)

These investigations gave sufficient data to allow of selecting a suitable location and estimating the depth to which the well would have to drill In this case the limit was set by the depth at which the well would cross the thrust fault below which point there would not be any structure capable of retaining oil irrespective of the depth factor It was therefore deduced that a well of not more than 6000 ft depth would be sufficient to test the area, and this decided the choice of drilling outfit, in this case a diesel engine outfit for Rotary drilling, of a type commonly used nowadays

The section in Fig 2 illustrates these deductions about structure and stratigraphy The stratigraphical names correspond to the divisions recognised in geological mapping in this region which are approximately

Dihing Series —Pliocene
Tipam Series —Mio Pliocene
Surma Series —Miocene
Barail Series —Oligocene & Eocene

and it will be remembered that the oil of the Digboi field is mainly found in the lowest Stage (Tipam Sandstone) of the Tipam Series The general expectations, as deduced from the geological mapping were therefore reasonably favourable

The site selected as being geologically suitable for the test well was by the usual perversity of nature, not at all readily accessible and one of the major items in the preparations was the grading and surfacing of a mile of new road and the improving of several miles of local roads to connect with the railway where a siding was installed to cope with the arrival of the hundreds of tons of material required Apart form the drilling outfit itself and its auxiliary plant a good deal of housing had to be built as more than 100 people had to be brought in for the drilling apart from casual labour recruited locally

The actual drilling of the well started in July 1949 and proceeded according to plan without any unusual event or mechanical hitch In this case the underground fluid pressures were approximately in hydrostatic balance unlike many other areas in Assam where pressures may be twice as great and special arrangements have to be made to prepare a mud fluid of high density and to maintain a pressure at the well head during the drilling The well was merely fitted with the normal control devices to cope with any excess pressures suddenly encountered and the drilling mud was of 80 lbs per cu ft density prepared from a local clay by the usual chemical treatment

The accumulation of oil in a structure requires the presence of both reservoir rocks (sandstones) and cap rocks (clays or shales) to hold the oil and for this reason as well as for geological correlation the lithology of the beds penetrated was of great interest As a continuous and routine measure samples were collected for the rock cuttings brought up by the drilling fluid as it circulated, and periodically special cores were taken so as to get larger specimens of exactly known origin for detailed examination and estimation of dip etc Stratigraphic correlation was by means of Heavy Minerals as fossils gave no help in this respect In addition to direct lithological evidence electrical surveys by the Schlumberger technique gave a detailed check on the lithology of the beds penetrated

For the direct detection of any signs of oil samples from the beds penetrated were given the usual tests by extraction with organic solvents such as Chloroform In addition use was made of the Fluoroscope, an ultra-violet light apparatus that has recently been adapted for this purpose which is a very delicate test for oil

As drilling proceeded it was confirmed that all the essentials of a reservoir were present in the way of sand stone beds with intervening shales but there was a complete absence of the essential factor of any indication of oil Nevertheless there was always the hope that although the upper horizons were barren of oil some lower beds might still contain it

The end of all hopes came, however when at about 2900 ft the well reached the main thrust fault and passed through it into beds of high stratigraphic horison with no indications of useful structure Drilling was continued to 3500 ft to make quite sure of the position and then the well was stopped and preparations made to abandon the area That was in October 1949 3½ months after drilling started

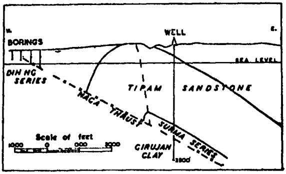


Fig 3 Transverse section showing sub surface evidence Tiru Hills (after Coates)

It was of course anticipated that the well would eventually reach the thrust plane and that the fault might come higher than the depth which had to be allowed for in the estimates but the actual depth was at about the extreme upper limit of the alternative possibilities having regard to the usual structural habits of faults in Upper Assam Thus the position of crossing the thrust was a considerable disappointment and meant that the range of beds available for oil accumulation in the area was only about half of what had been hoped

However the combination of the entire absence of oil indications and the unfavourable evidence obtained about the structure has at least proved unequivocably that the area is economically worthless The well just drilled had disposed of the question as regards the beds actually penetrated while there is no reason for supposing that this locality would offer any better prospects than any other in Upper Assam for anything that might be reached by very deep drilling in the beds below the Naga Thrust there is neither any reason for expecting local anticlinal structure nor any regional evidence of the existence of oil

One of the biggest potential sources of lost expenditure in oil prospecting is the class of area which in the initial test well gives just sufficient encouragement to make further drilling necessary before the area can conclusively be classed as valueless So that although it may seem strange to speak of a test well as satisfactory when it has failed to find oil that description might fairly be applied to the Tiru Hills well It definitely and rapidly achieved its object which was to discover whether the area was a potential oilfield and the outcome although disappointing is in keeping with the normal statistical chances of failure in oil prospecting Annual reviews of prospecting in the U S A show that there only about one such well in nine succeeds in finding a new oilfield and one may hope that the current disappointment will eventually be counterbalanced by success in some other area

The elimination of Tiru Hills as a possible oilfield adds one more to the list of adverse results in structures along the Naga Thrust but although this augments the general discouragement it does not necessarily completely condemn other similar structures along this belt Consequently the outfit employed at Tiru Hills is now to make another attempt at finding oil this time at Barsilla a few miles away on another structure and the results of this next test will be awaited with interest

RECENT ADVANCES IN THE KNOWLEDGE OF CELLULOSE

PART II —MODIFIED VARIETIES OF CELLULOSE

M K SEN

INDIAN JUTE MILLS ASSOCIATION RESEARCH INSTITUTE CALCUTTA

IN Part I of this series[1] reference was made to the two modifications of cellulose—Cellulose II and Cellulose IV—both having the same chemical structure as that of the native cellulose but with different crystalline structures Apart from these physical modifications there may be numerous chemical modifications of cellulose arising out of its specially reactive nature According to the site and nature of reaction the modified celluloses may be classified as (1) Hydrocellulose (2) Oxycellulose (3) Addition or Molecular compound cellulose (4) Cellulose esters and (5) Cellulose ethers The knowledge of the reaction mechanisms of chemically modified celluloses is of particular interest to the pulp industry and to the manufacturers of rayons films plastics and lacquers

HYDROCELLULOSE

When cellulose is treated with hot or cold acid depending on the strength of the acid and the time of treatment, the fibre is degraded The reaction mechanism has until recently been considered to be one of hydrolysis (i e addition of water) as shown in the following scheme the H ion of the acid acting only as a catalyst

---

[1] *Science and Culture* 14 501 1950

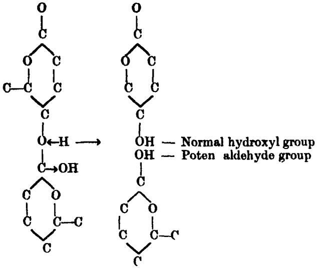


Fig 1

The effect of hydrolysis would, therefore, be the fission of chains at glucosidic linkages and the formation of two terminal residues—one with a reducing hemi acetal group and the other with an extra OH group This explains the increased reducing power of hydrocellulose as compared with native cellulose, whose reducing power is very low on account of the presence of only a small number of hemi acetal groups at the ends of long cellulose chains The methods generally in use for the estimation of reducing power are based on reactions with Fehling's solution, phenyl hydrazine, ethyl mercaptan and hypoiodite, each of which suffers from the defects of erratic results, lack of selectivity, and incomplete reaction Rise in copper number has been found to be correlated with drop in cuprammonium viscosity and decrease in tensile strength, indicating fragmentation of cellulose chains as a result of hydrolytic attack

Recently, a method for the estimation of reducing power using ice cold solution of potassium permanganate in dilute sulphuric acid, has been reported by Pacsu, and this is claimed to be free from the above deficiencies He has suggested a new cellulose formula having regular chains of anhydroglucose units cross linked by means of cellobiose units through half acetal bonds According to Pacsu, hydrocellulose is not what it is thought to be namely a modified cellulose consisting of fragmented cellulose chains having increased reducing power, in fact Pacsu's hydrocellulose possesses less reducing power than the original cellulose from which it is produced He assumed that the primary action of acid consists not of a cleavage of 1—4 glucosidic bonds, but of a rupture of the less resistant half acetal cross bonds This rupture is followed by the leaching out of the cellobiose units which are liberated from the structure, as a result the residue of regular chains having less reducing power ensues Pacsu's concept would, however, be considered in the light of the long known fact that the reducing power of hydrocellulose may be decreased or even almost eliminated by treatment with hot or boiling water. Obviously, the very chain fragments present having the greatest reducing power are soluble in water and washed out It is quite possible that such a reduction of the original reducing power would also occur during the preparation of the hydrocellulose In the case of an already much degraded cellulose for the starting material the portion of the original reducing power washed out may be in balance with that freshly produced, as a result of which a hydrocellulose having at least no higher reducing power than that of the starting material may ensue Similarly, the amount of reducing power freshly produced may be smaller than the original reducing power removed by washing, in which case there would be a hydrocellulose of smaller reducing power than that of the original cellulose

In a more recent communication Pacsu has laid emphasis on the equally spaced nature of the acid sensitive hemi acetal bonds, so much so, that he has supposed the presence of one such bond after every 128 or 256 glucose anhydride residues He has cited the results of Schultz and Husemann on the kinetics of degradation, and those of Gralen on the molecular weights of the varieties of native cellulose, in support of his theory

OXYCELLULOSE

The term oxycellulose refers to the results of oxidative treatment of cellulose Whenever any acid process is employed, say either in textile manufacture or the pulp industry, care must be taken to ensure a minimum formation of hydrocellulose and avoid excessive degradation of cellulose, similarly any oxidative treatment of textiles for bleaching or removal of colouring matters, such as for example by the chlorite and peroxide methods, may lead to severe tendering of the materials unless special precautions are taken According as the reaction takes place in an acidic or alkaline medium, oxycellulose generally may be either a reducing or a carboxylic type The reducing type of oxycellulose is characterised by copper number values, whereas the carboxylic acid type is indicated by methylene blue absorption index Compared with hydrocellulose the reducing type of oxycellulose is more reactive, perhaps due to the presence of a greater number of aldehyde (CHO) groups Unlike hydrocellulose a reducing oxycellulose does not indicate any correlation between its copper number, tensile strength and cuprammonium viscosity This has been ascribed by Davidson to the alkali labile linkages in the oxycellulose on account of which there is no cleavage of the chains, and hence no decrease in tensile strength, but the reduction of stability of the linkages in alkali ultimately resulting in the fission of the chains leads to low cuprammonium viscosity.

Speaking in general, oxidative treatments do not attack the 1—4 glucosidic linkages, but their action are confined either to the secondary hydroxyls, as in periodic acid oxycellulose, which result in the cleavage of the glucose ring between the carbon atoms 2 and 3, or to the primary hydroxyls bound with carbon atom 6, as in nitrogen dioxide oxycellulose. The mechanisms of such reactions are as shown in Fig 2 and 3

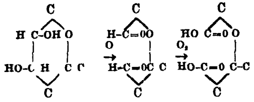


Fig 2 Periodic acid oxycellulose

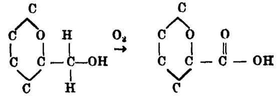


Fig 3 Nitrogen dioxide oxycellulose

The reaction mechanisms of oxycelluloses formed by other oxidising agents, namely hypochlorite, hypobromite and dichromate are rather complex, and cannot be easily formulated Another instance of varieties of reaction in this regard is provided by the comparative study of chromic and periodic acid oxycelluloses both of which are the reducing types but while there is no indication of change in the X ray diagram of cellulose after oxidation with chromic acid the X—ray diagram of periodate indicates destruction of crystalline celluloses The difference has been ascribed to the difference in the sites of the attack which, in the case of chromic acid, are the non crystalline regions, and in the case of periodate both crystalline and non crystalline regions

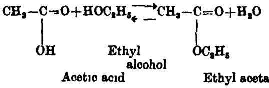
ADDITION OR MOLECULAR COMPOUND CELLULOSE

The forces involved in the formation of these compounds are rather loose as indicated by their reversion to native or hydrate cellulose after washing with water The chemicals capable of producing the addition or molecular compounds have the property of swelling the intracrystalline regions The swelling agents in general use are caustic soda solutions of appropriate strength, quaternary ammonium hydroxides, hydrazine, ethylenediamine, tetramethylenediamine, etc, of which the compounds corresponding to caustic soda and quaternary ammonium hydroxides revert to hydrate cellulose whereas those corresponding to hydrazine and diamines to native cellulose after washing with water The action of swelling agents on cellulose is to form hydrogen bonds with the hydroxyls which means substitution of cellulose—cellulose bonds in the ab planes of the unit cells by cellulose-swelling agent bonds With swelling agents having only one polar group such as caustic soda and quaternary ammonium, the effect is to rotate the plane of the glucose units in the unit cells by approximately 30°, so that they form bonds with the next neighbours in the centre of the cells, thus preventing reversion to the native form after washing, on the other hand, swelling agents, such as, hydrazine and diamines, having two polar groups, one at each end of the molecules, are capable of stabilizing the glucose chains in the ab planes of the unit cells, as a result of which the structures revert to native celluloses after washing

Of all the swelling agents, caustic soda is the most important from the technical point of view The treatment of cellulose with caustic soda and the use of the resulting product, alkali cellulose have been known by the textile industry for a long time Mercerisation, preparations of viscose and cellulose ethers, such as ethyl—, methyl, and benzyl celluloses, etc require treatments of cellulose with alkali Regarding the reaction mechanism of alkali cellulose, the chemical and physical evidences support the theory that the alkali is in chemical combination with the cellulose, although opinions are divided as to whether the compound is of the alcoholate type with a covalent bond between the Na atom and the oxygen atom of cellulose, or the type of addition compound as found in the hydrate of copper sulphate which is rather a loose union between the alkali and the cellulose The majority of opinions are in support of the theory of addition compounds, namely $2(C_6H_{10}O_5)NaOH$ in this connection there have been claims of recording more than half a dozen different addition compounds of alkali and cellulose obtainable by treatments with various concentrations and temperatures of alkali solutions

CELLULOSE ESTERS

The product of reaction between alcohol and acid with elimination of water, is known as an ester For example



$$\underset{\text{Acetic acid}}{CH_3-\underset{OH}{\underset{|}{C}}\rightarrow O}+\underset{\text{Ethyl alcohol}}{HOC_2H_5}\rightleftarrows \underset{\text{Ethyl acetate}}{CH_3-\underset{OC_2H_5}{\underset{|}{C}}=O}+H_2O$$

The reaction is reversible and there will be a hydrolysis of ester formed unless water is removed from the sphere of reaction by the use of a dehydrating agent Cellulose by virtue of the presence of the alcoholic groups CHOH and CH_2OH, resembles polyhydric alcohols, and permits formation of esters The inorganic ester of commercial importance is the nitrocellulose, which is used largely for explosives, celluloid plastics and lacquers Usually, the method of manufacture employs a mixture of $HNO_3-H_2SO_4-H_2O$ with varying ratios of the components By proper adjustments of the conditions of reactions it is possible to obtain nitrocellulose with a nitrogen content of 13 8% which is very close to the theoretical maximum of 14 14%, corresponding to the formation of trinitrate Since the reaction is reversible, it is necessary to displace equilibrium by using excess of acid and in order to remove one of the products of reaction, water, for which purpose H_2SO_4 is included in the mixture While various explanations have been offered for the role of sulphuric acid in the nitration reaction, there is no reason to believe that it performs any other useful function than that of dehydration The knowledge that cellulose can be nitrated equally well by nitric acid containing other dehydrating agents such as phosphoric anhydride and acetic anhydride etc lends support to this view There are two theories regarding the manner in which the nitration reaction takes place in cellulose fibres According to one theory it is a heterogeneous reaction proceeding progressively from the outside to the interior of the cellulose crystallites On the other hand there is the other theory supported until recently by the majority of investigators which suggests that the reaction is homogeneous the nitration taking place uniformly into all parts of the fibre and all the molecules being nitrated at approximately the same time Recently Mathieu has reported in support of the heterogeneous reaction theory a continuous cinematographic X ray study of cellulose in the process of nitration employing a high power X ray tube capable of giving one photograph every two minutes He has found that the structure of cellulose changes successively as indicated by—(1) disappearance of all periodicities along the fibre axis except that corresponding to the cellobiose group (2) disappearance of reflections 101 and 10$\bar{1}$ and (3) appearance of the fibre period belonging to trinitrocellulose *i e* 25 6 Å

The commercial nitrocelluloses differ in respect of nitrogen content solubility and viscosity It is possible by preventing the associated hydrolysis to prepare materials without any degradation of chain length Thus guncotton manufactured under anhydrous conditions is almost of the same degree of polymerisation as that of the original cellulose whereas a nitrocellulose rayon which is the result of treatment under excess of water is a material of low degree of polymerisation (D P) The manufacture and use of nitrocellulose for textile purposes are limited on account of its highly inflammable nature However in the commercial practice of making filaments acetone solutions of the materials are coagulated from the spinning bath by using a non solvent or an electrolyte and the resulting yarns are subsequently saponified (*i e* hydrolysed for denitration) by treatment with alkali sulphide solution Saponified nitrocellulose is much less easily combustible than the ordinary variety A completely saponified material gives a mixed X ray diagram of native and regenerated (*i e* mercerised) cellulose The other use of nitrocellulose apart from that for textiles and explosives lies in the manufacture of celluloid plastics where camphor is used as a plasticising agent In this case although stoichiometric relationships between camphor and nitrocellulose are uncertain there are evidences of formation of several addition or molecular compounds as revealed from the characteristic X ray diagrams Under special condition of treatment it is possible to get a compound characterised by a fibre period 38 3 Å in the X ray diagram

Of the numerous products of esterification by organic acids, cellulose acetate is the most important from the industrial point of view The commercial method of acetylation employs acetic anhydride in the presence of a catalyst H_2SO_4 The role of of catalyst in general is (1) to form addition compounds with the cellulose and thus open out the inaccessible regions in the heterogeneous structure of cellulose for subsequent reactions with acetyl groups and (2) to cause hydrolytic breakdown of cellulose chains for increasing the solubility of the acetate From a study of the progressive change in X ray diagram with increasing degree of acetylation it has been noted that up to an acetyl content of 30% there is practically no change in the X ray diagram which gradually indicates more and more diffuse equatorial reflections with further increase in the acetyl content Finally at about 62% acetyl content which is that corresponding to the formation of triacetate a new X ray diagram makes its appearance

The substitution reaction in cellulose does not occur in such a simple manner as shown by the chemical equation connecting an alcohol and an acid According to modern concepts due to Frey Wyssling Kratky and Hermans a swollen cellulose gel consists essentially of a molecular network structure The junction points of the network have the character of regions of increased lateral order (*i e* crystalline region) where the cohesive energy between the chains approaches its maximum value whereas the cohesive energy is smaller between the less ordered chains interconnecting the junction points (non crystalline regions) During chemical reaction the glucose residues in the non crystalline regions should be more readily and hence sooner affected than those forming the junction points provided swelling in the reaction medium is not intra crystalline Recently Hermans has concluded from measurements of swelling birefringence and acetyl content on acetylated as well as saponified model cellulose filament that the degree of substitution is dependent upon the accessibility of the sites of reaction

Numerous methods of manufacturing cellulose acetate have appeared in the patent literature Procedures vary in respect of pre treatments of cellulose to increase the reactivity nature of solvents and subsequent hydrolytic and precipitating agents The operations involved in the making of acetate filaments consist of esterification to give a dry flake and downward extrusion in hot air of the acetone solution of the flakes whereby acetone is evaporated leaving behind the threads The ordinary yarns are of low tenacity and high extensibility The X ray diagram of such yarns is a diffuse and disoriented mixed pattern of native and hydrate cellulose Recently a very high density acetate yarn has appeared under the trade name Fortisan which gives a very sharp and highly oriented X ray diagram Its method of manufacture consists of saponification of ordinary acetate yarn preceded by stretching to increase crystallinity and orientation

Artificial silks and rayons as they are generally known, can be made of nitrocellulose cellulose acetate and cuprammonium cellulose But the cheapest and perhaps the best and hence the most popular variety is what is called viscose The viscose reaction can be written in a rather over simplified manner as follows

$$R_{\cdot 1} - ONa + SCS \rightarrow R_{\cdot} -- OCSS\,Na$$

When cellulose is treated with alkali to form alkali cellulose (or soda cellulose) and then reacted with carbon disulphide (CS_2) it gives the sodium salt of the cellulose ester of dithiocarbonic acid commonly known as xanthate The actual reaction is far more complicated than what is expressed in the simple chemical equation since in addition to the main reaction between alkali cellulose and CS_2 side reactions also occur as a result of which the secondary products consisting of carbonate trithiocarbonate sulphide and hydrosulphide are present in the system Unlike the trinitrate and triacetate the trixanthate does not form readily the average degree of xanthation in commercial viscose being about one xanthate group per two glucose residues If however cellulose is dispersed before addition of CS_2 then trixanthate is formed Since an X ray diagram of commercial xanthate indicates only the presence of soda cellulose it strongly suggests that xanthation occurs only in the non crystalline regions

For the manufacture of viscose filaments a number of operations are necessary such as (1) treatment with caustic soda (2) pressing to remove excess alkali (3) shredding to expose surfaces for subsequent reactions (4) aging of soda cellulose (5) xanthation of soda cellulose (6) preparation of xanthate solution (7) ripening of xanthate and (8) spinning The pulp to be subjected to treatment has to satisfy certain tests regarding α cellulose hemicellulose and metal impurity content although chemical analysis alone is not enough to establish the value of a pulp for viscose manufacture The final decision regarding the utility of given type of cellulose is made after converting it into viscose and the particular end product e ther filaments or films

The strength of the caustic soda solution for treating sheets of pulp varies between 15 20% and the steeping operation lasts from 15 minutes to one hour at 20 30°C The pressed weight after alkali treatment is about three times the weight of the original cellulose After pressing and shredding the alkali is stored for two to three days in a constant temperature at 25 30°C Oxidative degradation hastened by catalytic influences of metallic impurities in the pulp occurs during this period of aging so that on xanthation and solubilisation a product of appropriate viscosity for the final stage of spinning ensues The xanthate reaction is permitted to continue for two to four hours at 25 35°C either at atmospheric pressure or under vacuum and the quantity of CS_2 added is usually about 30 40% The xanthated cellulose is dissolved in 8 12% caustic soda by agitating in the solution for 3 6 hours The fresh xanthate solution is not amenable to easy coagulation and hence it is necessary to mature or ripen it at 20 25°C for two to four days during which time partial coagulation starts through spontaneous decomposition of the xanthate The ripened viscose solution after filtering is forced through spinnerets immersed in a coagulating bath which consists generally of dilute solution of H_2SO_4 and sulphate There are in addition, the important operations subsequent to spinning, namely washing desulphuring bleaching drying etc

The composition of the coagulating bath has been the subject of extensive investigations and numerous formulæ covered by patents have appeared in the literature The chief functions of the bath are to decompose the remaining xanthate and to coagulate at a suitable speed the dispersed cellulose in the viscose solution The action of acid is to decompose the xanthate and that of salt is to reduce the speed of regeneration through change in *pH* as well as to increase the coagulating power The use of various salts in the bath is of special interest n stretch spinning processes required for high tenacity v scose filaments The retarding action of zinc *sulphate on the decomposition of xanthate* and *its in*crease with the increase in concentration of the salt have been utilised for the manufacture of high tenacity viscose filaments under the trade name Tenasco Composition of the bath also influences the filament cross sections *e g* high swelling bath composed of sulphuric acid alone gives a circular smooth cross section with no skin low swelling bath produced by high salt concentration gives an irregular serrated cross section with skin Besides the composition of the bath the important factors in the spinning operations are bath temperature spinneret composition spinning speed spinning tension and stretch

The theory of the deformation mechanism of viscose rayons as related to orientation stretch and shrinkage has been developed by Sisson Kratky and Hermans Although orientation may be produced in the spinneret as evident from the streaming birefringence of viscose in passing through an orifice it is probable that this affects mainly the orientation of chains to form crystallites The final crystallite orientation in the filament is governed by the degree and type of shrinkage on drying or stretch imparted on subsequent processes The orientation is random if there is swelling or shrinkage along the three axes uniaxial (*i e* preferred orientation of fibre axis relative to the direction of shrinkage or stretching) if shrinkage is along two axes or elongation along one axis and shrinkage along two uniplanar (*i e* preferred orientation of 101 plane) if shrinkage is along one axis or elongation along two axes and shrinkage along one According to Kratky the orientation of the crystallites upon deformation follows the rule of affined transformation *i e* the crystallites are supposed to be embedded in a plastic matrix and are dragged along with the matrix following its dimensional changes In an attempt to obtain experimental verification of Kratky s theory Hermans by using the X ray method has studied the changes in orientation with deformation of viscose filaments and observed that as required by the theory the orientation of 101 plane runs ahead of the orientation of $10\bar{1}$ and 002 planes the average orientation is a function of reduced elongation, v_s ($= v\sqrt[3]{q_1/q_t}$ where v = the actual elongation q_1, q_t are initial and final degrees of swelling), on the other hand the increase of average orientation with stretch, is almost twice as much as required by the theory.

Yet another interesting field of study of viscose rayon filaments has been opened in recent years and that is with regard to the structural details of skin and core in the viscose filament cross sections Using *suitable* staining techniques both Sisson and Hermans have observed that viscose rayons under different conditions of manufacture regarding the degree of polymerisation of original cellulose aging periods concentration of CS_2, acidity or alkalinity of the bath and concentration of salts show varying thicknesses of skin and core, the former more deeply stained than the latter with dyes such as Victoria Blue Bordeaux Extra etc Originally it was supposed that the crystallites in the skin were more highly orientated than those in the core but according to Sisson higher orientation is not the only factor which differentiates a skin from a core another factor is the lower degree of lateral order in the crystallites Flod has published some interesting results of experiments on the topochemical reactions with native and viscose fibres under varying degrees of acetylation The method consists of peeling like an onion successive layers from the fibres by acetylating and dissolving out in a solvent (mixture of chloroform and methyl alcohol) and measuring the density and swelling of the peeled fibres He has concluded that the density increases radially from the centre outwards in native and viscose fibres indicating a possibility of higher density of the skin

CELLULOSE ETHERS

Commercial interest in the ethers of cellulose is of recent origin although etherification as a means of studying the structure of cellulose has long been known Highly substituted ethers find applications in the plastics films and lacquer industries The usual method of attaching alkyl groups is to utilise the reaction of alkali cellulose with the corresponding organic ester as shown below

$$R_{cell} - ONa + RCl \longrightarrow R_{cell} \longrightarrow OR + NaCl$$

The ease of etherification depends on the rate of diffusion of the etherifying agents into the swollen alkali cellulose Smaller molecules such as methyl and ethyl chlorides diffuse more readily and hence alkylate more easily than the higher alkyl chlorides of bigger molecule size The theory of the mechanism of substitution as related to solubility of cellulose ethers has been worked out by Bock Spurlin and others The water solubility of the methyl or ethyl cellulose is supposed to be due to unetherified hydroxyl groups made available for hydration because of the spacing apart of individual chains by the respective ether groups Thus if an insufficient proportion of hydroxyls is etherified the wedging action of the ether groups may not be enough to make unetherified hydroxyls available for hydration as a result of which the product may only swell without dissolving On the other hand the substitution may be too high in which case there may not remain enough hydroxyls for hydration and so the product again may only swell without dissolving

Modified celluloses form a wide range of articles of every day use and although there is as yet no such thing as a man made cellulose fibre in textile use the success achieved in the art of improving upon Nature s handiwork as exhibited in the making of artificial silk fibres is striking

---

ECONOMIC USE OF COAL BY INDIAN RAILWAYS

D PRAMANIK

CHARTERED FUEL TECHNOLOGIST CALCUTTA

IN India there is an output of nearly 26 million tons of coal per year and out of this quantity approximately 9 million tons i e 35% of the annual output are being consumed by the Railways alone

Here are two important points to be noted

(i) that the Railways are by far the biggest and the most important consumer even now of the best quality of Indian coal

(ii) that out of their total requirement some 10% (i e , 0 9 million tons) of Sel A 20% (i e 1 8 million tons) of Sel B 50%(i e 4 5 million tons) of Gr I and 30% (i e 2 7 million tons of Gr II coal are being taken by the Railways per annum

USE OF COAL IN RAILWAYS*

Depending on the nature and character of the job the purposes for which coal is used in Railways may be classified as follows —

I Locomotives and Locosheds
II Engineering workshops and miscellaneous
III Power houses
IV Water pumping purposes

The respective consumptions of these different classes will now be analysed in brief

---

*Figures given under this head apply to the Railways in the Indian Union and are obtained from the latest statistical records of the Railway Board

I Locomotives and Locosheds consume about 90% of the total railway coal consumption

In this case again the following sub divisions can be made

A Locomotive coal requirement

(i) Passenger and mixed train consume	30% of the total railway consumption	
(ii) Goods trains	42 3%	
(iii) Shunting locos	11%	
	83 3%	
B Locosheds consume	6 7% of the total railway consumption	
II Miscellaneous(including Engineering works) consume	5 0%	,
III Power houses	2 5%	,
IV Water pumping purposes	2 5%	,
Total	100 0%	,

Thus roughly about 83% of the total coal required for Railways is consumed by the locomotive boilers and the remaining 17% by stationary boilers and other coal consuming appliances We can therefore split up the consumption as under

(a) For locomotive boilers 7 470 000 tons per year and (b) in stationary condition 1 530 000 tons per year

NOTES ON POSSIBLE ECONOMY UNDER DIFFERENT CONDITIONS

A *Locomotives* (*i e* coal used in boilers under moving condition)

In designing a Locomotive to attain higher thermal efficiency there are numerous factors among which the following (are a few that always) have adverse influence at all times

(*i*) Limited space
(*ii*) Weight of the machine
(*iii*) Gradient of the land
(*iv*) Human limitation of the operator

In this paper instead of going into the technical details on locomotive designs, I should like to deal with such facts as are commonly known It is well worth noting that the overall thermal efficiency of an Indian locomotive is on an average about 5% and if this efficiency is improved and raised to 6% a fuel saving of approximately 16% of the net coal consumption can be effected and this will amount to 1 195 000 tons per year Inversely if the efficiency suffers a drop from 6% to 5% through neglect and improper operation and maintenance the annual coal consumption will be increased by 1 195 000 tons per year and this at Rs 20/ per ton (including cost handling charge and freight of coal) will involve an extra expenditure of Rs 23 900 000/ per year It is also known that in other countries with hand fired steam locomotives an overall efficiency even upto 9% has been attained and that 8% efficiency is quite a common practice Under favourable circumstances when 9% overall efficiency can be achieved the locomotives in the Indian Railways operating at only 5% efficiency are wasting as much as 40% of the total coal consumed *i e* about 3 *million* tons a year costing about 6 crores of rupees Obviously the Railways have before them the great responsibility of effecting economy in coal consumption by taking to improved method of maintenance and management of the locomotive boilers

It may be mentioned in this connection that lately methods have been developed and prime movers have been designed by research to raise the standard of locomotives to as much as 18% and that even higher efficiency may not be beyond expectation by continued research But it must be remembered that the maintenance of the standard of efficiency of a machine always depends on how well it is operated and looked after

B *Coal used under Stationary Appliances in Railways*

In stationary conditions 1 530 000 tons of coal are consumed per year From my personal experience and knowledge I can say that there has been rather poor efficiency in running many of the stationary boilers in the Railway Pumping Stations leading to wastage of as much as 30% of the coal consumed by the Railways under this head This would amount 459 000 tons of coal per year Moreover coke breeze may conveniently be used in place of coal thereby releasing a good of high grade coal for other better uses

From what has been said above it may be summarised that due to the present imperfect and inefficient method of running the boilers there is a total annual wastage of coal amounting to 3 459 000 tons which would mean an inflation of coal bill by Rs 69 180 000 per year *i e* about 7 crores of rupees more than what it should be By proper handling of the situation the railway income could be increased by this sum of money and about 3 5 million tons of coal could be saved to feed the different industries in this country This quantity of coal engages 172 950 wagons per year *i e* 474 wagons per day which could otherwise be utilised to bring more income to the Railway

The magnitude of this colossal waste can be pictured from the following comparisons

(*i*) This is equivalent to twice the annual coal consumption of the Tata Iron & Steel Co Jamshedpur

(*ii*) This is equivalent to the sum total of the coal consumption of all the Textile mills and Power houses in India

(*iii*) This is equivalent to three times and a half the coal consumption of all the cement factories in India

CONCLUSION

It may be said in conclusion that in view of the reduced load on the grate when the overall efficiency is improved in the locomotive boilers there might be great possibility of using coal with higher ash content (say up to 24% ash). This will lead to the extraction of more of second grade coal from mines. This will not only release 3.5 million tons of coal per year to be used for other industries but will also help in the extraction of second grade coals. The total output target of coal in different collieries should accordingly be revised.

From what has been said above it is quite clear that the existing methods of running the boilers in the Indian Railways are not always very efficient and by carefully manipulating the operating technique the efficiency could be greatly improved thereby putting a stop to huge wastage of coal and bringing more income to the Railways.

INCIDENCE OF CHOLERA IN CALCUTTA AND ITS DEPENDENCE ON SEASONAL FACTORS

MAHABIR RAY

STATISTICIAN, CALCUTTA CORPORATION

LIKE many other epidemic diseases in the city of Calcutta Cholera too follows the seasons in a predictable manner but the ignorance, religious prejudices as well as the environmental conditions of the people give a fillip to the growth of the disease and may affect its normal course to a marked extent.

The city of Calcutta besides being an important trade centre and the seat of the Provincial Government enjoys the enviable distinction of being a most prominent and easily accessible place of pilgrimage of the Hindus. The religious festivals of the Hindus are many occurring almost all the year round and are characterised by a large influx of pilgrims resulting in heavy congestion and insanitation and frequently causing cholera to break out. These irregular outbreaks superimposed on the seasonal pattern sometimes tend to confuse the intrinsic relation between the growth of the disease and the change in the climatic factors.

It is proposed to study statistically the dependence of the disease on the prevailing mean temperature and the mean variation in temperature (maximum temperature minus minimum temperature) use being made of the mortality statistics in the absence of reliable morbidity figures.

In Calcutta deaths from cholera are usually in evidence in November and December gradually rise in January, February and March generally reach a peak in April, start declining in May and finally subside in June. This course gives the normal type with the maximum in April.

The variants of this type are those (1) with an early maximum (e.g. maximum in January in 1907) and (2) with a late maximum (e.g. maximum in June in 1920) with usually double rise i.e. two outbreaks in the year. A rather rare type with treble rise or three outbreaks in the year was noticed in 1900.

The mortality rates from cholera for most of the years give normal type curves, the Table I for this type of graph contains the monthly death rates from cholera (averaged over 40 years 1900-1911 and 1917-1944, the data for the intervening period not being available) in conjunction with the normal mean temperature and normal variation of temperature (average of 65 years) for the corresponding month. By the principle of Inertia of Large Numbers the Table contains the data for the normal type cholera curve. It may incidentally be added that in this Table the monthly death rates are important not so much for their absolute magnitudes as for their relative values.

The data for the rather abnormal years 1900, 1920 and 1907 have been given in the Tables II, III and IV with the results of statistical analysis noted below each.

It may be added that the following regression equation has been used: $y = b_1(x_1 - \bar{x}_1) + b_2(x_2 - \bar{x}_2)$ where

y = death rates or the nos. of deaths from Cholera

x_1 = the monthly mean temperature

x_2 = the mean variation of monthly temperatures (mean maximum minus mean minimum) and the quantities under the bar representing the average values.

It will be seen from Table I that the death rates

TABLE I (Normal Type)

Months	y	x_1	x_2
January	209	67.1	25.0
February	175	71.6	24.3
March	313	80.7	23.7
April	448	86.2	21.3
May	350	86.5	18.1
June	196	85.5	13.8
July	112	84.1	10.9
August	062	83.6	10.7
September	065	84.0	11.9
October	103	81.5	15.4
November	144	73.9	20.5
December	142	67.2	24.4
Total	2,319	951.9	220.0

Here

y = monthly death rate from cholera (average of 40 years)

x_1=Normal mean temperature for the month
x_2=Normal variation in temperture for the month

$$\left.\begin{array}{l} b_1=0\ 01873 \text{ with s e }=0\ 00247 \\ b_2=0\ 02798 \text{ with s e}=0\ 00327 \\ b_2-b_1=0\ 00925 \text{ with s e}=0\ 00230 \end{array}\right\} \begin{array}{c}\text{Significant} \\ \text{even on} \\ 1\% \text{ level}\end{array}$$

$$\begin{array}{ll} r_{x_1y}=0\ 223 \text{ (insignificant)} & r_{x_1y}x_2=0\ 930 \\ r_{x_2y}=0\ 492 \text{ (insignificant)} & r_{x_2y}x_1=0\ 944 \end{array}\Big\} \begin{array}{c}\text{Significant} \\ \text{on } 1\% \text{ level}\end{array}$$

from cholera depend in a remarkable manner on the mean temperature and the mean variation of temperature for a normal type cholera curve The death rates increase when the mean temperature increases and also when the mean variat on of temperature increases and the increase is strongly significant in the case of both the climatic factors under consideration

In the data for the year 1900 as given in Table II there are three rises the spring rise being the seasonal out break the June rise being occasioned by the influx of pilgrims from the *Rathjatra* festival at Puri and the September rise being due in the opinion of the then health authorities to the floods having got into the mains particularly at the suburbs

TABLE II

(Data for 1900—Treble rise)

M nths	y	x	x_2
January	127	69 9	21 4
February	213	74 7	20 6
March	393	82 7	22 6
Apr l	475	86 5	20 1
May	278	85 9	19 4
June	316	85 7	12 8
July	171	84 5	10 5
August	80	83 9	10 1
September	255	82 4	9 6
October	168	81 6	14 2
November	120	73 9	20 6
December	156	69 2	22 1
Total	2754	960 9	203 9

Here

y—no of deaths per month
x_1=Mean temperature for the month
x_2=Mean variation of the temperature for the month

It is found that

$$\left.\begin{array}{l} b_1=17\ 6464 \text{ with s e}=4\ 15 \\ b_2-17\ 2354 \text{ with s e}=5\ 14 \end{array}\right\} \text{significant on } 1\% \text{ level}$$

b_1-b_2=0 4110 with s e =4 56 insignificant

In the data of 1920 as given in Table III there was the peak in June followed by another sharp rise in November

TABLE III

(Data for 1920—Late Maximum and Double Rise)

Months	y	x_1	x_2
January	78	67 4	21 3
February	120	71 8	19 9
March	291	60 0	17 3
April	290	85 4	17 5
May	286	87 3	18 6
June	386	88 8	15 4
July	268	84 2	9 3
August	69	83 8	9 6
September	50	84 0	10 3
October	110	81 8	12 3
November	210	74 5	18 5
December	144	66 6	23 2
Total	2302	955 6	193 2

Here

y=number of deaths (from cholera) per month,
x_1 =Mean temperature
x_2=Mean Variation in Temperature} Averaged over the month

It is found that

$$\left.\begin{array}{l} b_1=15\ 13896 \text{ with s e}=4\ 098 \\ b_2-19\ 13769 \text{ with s e}=0\ 657 \end{array}\right\} \begin{array}{c}\text{bordering on signifi} \\ \text{cance even on 1 per} \\ \text{cent level}\end{array}$$

b_2-b_1=3 99873 with s e=4 9 insignificant

The data for 1907 given in Tabel IV contain an early maximum and double rise That year there occurred the *Sagore Mela* and a solar eclipse in the early part of January causing a large influx of pilgrims and culminating in a peak of cholera mortality in that month this was followed by another sharp rise in November after the *Ras yatra* festival

Statistical analyses sub joined to the Tables indicate that in the apparent abnormal types of 1900 and of 1920 the intrinsic relation between the number of deaths and the climatic factors is significantly in evidence while in the case of 1907 it is not so In the last case the impulses of external influences have unrecognizably altered the normal course of the disease

TABLE IV

(Data for 1907—Early Maximum and Double Rise))

Months	y	x_1	x_2
January	1122	68 5	22 2
February	278	71 9	21 1
March	243	77 5	20 2
April	211	83 6	19 5
May	211	86 2	18 9
June	208	85 1	12 2
July	187	84 4	9 9
August	109	83 8	9 2
September	125	84 4	11 2
October	244	82 6	16 7
November	507	74 4	22 3
December	358	66 7	21 8

Here y,x_1 x_2 have the same significance as in Table III
It is found that

b_1= −21 9755 with s e=13.88
b_2= 8 7637 with s,e=2895, insignificant

It may be added that the fortnightly figures of attacks and deaths from cholera in the city for the whole of the year 1948 were analysed to find out their relation with the corresponding values of mean temperature and mean variation of temperature and that the positive regression coefficients obtained were found significant even on 1% level

The numbers of monthly deaths from cholera in the provinces of Bombay and Orissa for the year 1946 (available from the Public Health Commissioner s Report for 1946) were analysed in conjunction with the estimated monthly mean temperature and mean variation of temperature for the whole province The temperature data are available only for a few stations of the province and the median (being unaffected by ex tremes) was taken to represent the estimated mean value for the whole province

In the province of Bombay the number of affected villages was nearly 0 5 per cent and the number of deaths was few The regression coefficient of the number of deaths on the Mean Temp was significant on 5% level but that on the mean variation of temperature was insignificant

For the province of Orissa the number of affected villages was nearly 10 per cent, the number of deaths was large and the diseases may be said to have been rather widely prevalent The regression coefficients of the numbers of deaths on the corresponding monthly mean temperature and mean variation of temperature are both strongly significant even on 1% level The data for Orissa are given in Table V

From the above it may be concluded, that for the seasonal pattern of cholera, at least in the city of Calcutta, the death rates increase significantly with an increase in mean temperature as well as in mean variation of temperature, though for a particular year the usual pattern may be disguised by the influence of external factors

TABLE V

Cholera Mortality in Orissa (1946)

Month	y	x_1	x_2
January	486	68 0	27 2
February	985	75 7	23 8
March	1 622	82 8	22 2
April	691	83 9	16 8
May	799	88 4	17 7
June	389	85 6	14 3
July	437	82 9	9 6
August	259	82 9	9 5
September	399	83 4	11 4
October	363	81 4	12 5
November	479	77 5	15 6
December	300	72 3	19 5
Total	7209	964 8	200 1

Here

y=total number of cholera deaths in the month

x_1—Mean of the maximum and minimum temperature averaged over the month

x_2=Difference between maximum and minimum temperature averaged over the month

It is found that

b_1—51 0576 with standard error= 14 99
b_2=69 2799 with standard error=15 56
both significant even on 1% level

ARTIFICIAL RADIO-ACTIVITY AND ITS APPLICATIONS

IRENE CURIE

DIRECTOR, INSTITUT DU RADIUM, PARIS

THE discovery of radio activity by Henri Becquerel took place in 1896 Henri Becquerel discovered the radio-activity of uranium, the heaviest element already known, which had been studied by the ordinary method of chemistry Soon afterwards Marie Curie and Schmidt discovered independently the radio activity of thorium which was also a well known element In 1898, Pierre and Marie Curie saw that uranium minerals contained some more radioactive substances By a new chemical method of work, controlling the result of every chemical separation by the measurement of the radio activity of its portions, they discovered polonium and radium This method is still the basis of radio chemistry Polonium and radium were new unknown elements of atomic number Z=84 and 88

Their discovery gave impetus to a very great amount of work in France, England, Germany, and Austria Many new radio elements were soon found, some of them by the chemical method inaugurated by Pierre and Marie Curie, some by the study of the radiations

There exist about forty natural radio elements Most of them are elements which varies from Z 81 to 92, and form three families of atoms related by filiation —uranium radium, actinium and thorium families A few of them, very long lived, have lower atomic number—namely potassium, rubidium and samarium

The radio-elements undergo spontaneous transmutation, with the emission of α rays and β rays, accompanied some times by the emission of γ rays In the emission of α rays the mass number M decreases by four units, and the atomic number Z by two units In

---

* Full text of lecture delivered on the occasion of the award to Madame Irene Curie of the Joy Kissen Mookherjee Gold Medal of the Indian Association for the Cultivation of Science.

the emission of β rays (negatively charged electrons) the mass number remains the same and the atomic number increases by one unit

$${}^{226}_{88}\text{Ra} \longrightarrow {}^{222}_{86}\text{Rn} + {}^{4}_{2}\text{He}$$

$${}^{210}_{82}\text{RaD} \longrightarrow {}^{210}_{83}\text{RaE} + \overset{-}{\beta}$$

Of course these natural radio elements could not have a place by themselves in the Mendeleeff classification Some of them have the same Z and a different value of M—they are called isotopes Their chemical properties are exactly the same but their radioactive properties are quite different Some of them are isotopes of the stable atoms of lead bismuth and thallium Isotopy was discovered by Soddy forthe radio elements but exists also in stable elements as it was shown by Thomson For instance chlorine is composed of two sorts of atoms inseparable by the ordinary chemical methods of mass 35 and 37 and most of the elements are a mixture of two isotopes or more

In 1930 about 330 stable atoms and 40 natural radio elements were known The first artificial transmutation was discovered by Lord Rutherford in 1919 In 1934 Frederic Joliot Curie and myself discovered that artificial transmutation does not always transform a nucleus into another known stable nucleus but may produce a new radio active nucleus unknown in nature

The discovery of the first artificial radio element determined an extraordinary rapid development in radio activity New radio elements were produced by the use of every kind of particles making transmutations At the time of our discovery there were already many radio active atoms formed in the material surrounding the first cyclotron of Lawrence

Some of the artificial radio elements present new types of radio activity The first that we have formed ^{30}P and ^{13}N emit positive electrons

$${}^{30}_{15}\text{P} - {}^{30}_{14}\text{Si} + \overset{+}{\beta}$$

Other radio active atoms transform by capturing an electron from the outer shell mostly K electrons

Others are ' isomers They have the same mass number and atomic number but one of the nuclei is in an excited state which can last for minutes or hours before the excited atom emits a γ ray and returns to the fundamental state

Now, about 700 radio elements are known Most of them are isotopes of stable atoms Some represent elements missing in nature 43 61 85 and others discovered by Seaborg and his collaborators are transuranium 93 to 96 neptunium plutonium, americium, and curium

For practical use radio elements can be produced by the cyclotrons or by the nuclear reactor The big uranium piles can produce enormous amounts of radio element equivalent kilograms of radium or even tons by the processes of transmutation by neutrons discovered by Fermi or by the processes of fission of the uranium itself

The cyclotron does not produce so intense radioactive sources but can be used to obtain a greater variety of radio elements by different nuclear reactions in particular positive electron emitters and capture K which cannot be made in a pile It is useful to have both cyclotrons and uranium piles for the production of radio elements

Artificial radio elements can be used in two different ways either as powerful sources of radiations or as radio active indictors or tracers

As sources of radiations radio active cobalt for instance can be used in the same way as radium for therapeutics of cancer or for radiography of thick metallic pieces

The method of tracers was discovered by Hevesey and Paneth in 1912 and consists in following the compartment of stable atoms by mixing them with the radio active isotopes

As tracers the artificial radio elements can be used for many studies of pure or applied science which could not be made by other means or for studies which can be made by other methods but not so easily for radio elements can be measured easily and quickly by the use of counters or ionization chambers while the dosage of stable elements by chemical means are sometimes very long and tedious particularly for the micro quantities

In chemistry the tracers give new methods of micro analysis For instance a mixture of stable element with one of its radio active isotopes can be used very simply to determine the solubility of very insoluble compounds or very feeble tension of vapours of some substances Such determinations can be made by the ordinary methods but with much greater difficulty It is also possible to establish methods of dosage of inactive elements using radio active tracers as reactive The tracers have been used for the study of the exchange of atoms between different molecules For instance active atoms of chlorine in a chloride exchange with the atoms of another chloride but not with the chlorine of chlorate so that a chlorate mixed with active chloride and separated again remains inactive They can be used also to understand the structure of certain molecules or the mechanism of certain chemical reactions

One of the first application of tracer methods was to determine the diffusion of lead atoms in lead Such an experiment can evidently not be made with ordinary lead, but the diffusion of the isotopes of lead RaD in ordinary lead can be measured

The studies of diffusion of impurities in a metal or of one constituent of an alloy in the alloy or of autodiffusions can give important results in metallurgy and will certainly be developed when the technique of the use of radio elements will be more familiar to the engineers

The most important applications of the method of indicators have been made in biological studies It is possible to introduce radio active atoms in the organism and to study its metabolism For instance if radio active phosphorus is given to a rat in a short time its teeth become radio active showing that the atoms of phosphorus in the teeth are not always the same but exchange with the phosphorus of other parts of the body

But much more complicated processes can be studied in that way Prof Joliot Curie who has made some biological work with Prof Courrier has studied iodine metabolism of ionic iodine and of thyroxine They have shown that radio active thyroxine injected to a female does not go through the foetal membrane into the foetus on the contrary if ionic active iodine is injected it passes in the foetus which elaborates radio active thyroxine It shows that the foetus makes its own thyroxine

One has begun also to inject radio active iodine for curative purposes Knowing that it concentrates in the thyroid it is used to irradiate internally the cancer of this gland that kind of utilization will certainly develop in the future

You can see by those few examples that many other uses of the radio active elements can be imagined In France we began this kind of work with the small cyclotron made by Frederic Joliot-Curie in College de France now the experimental uranium pile of the Commissariat of Atomic Energy (Commissariat à l Energie atomique) in France gives us the possibility of getting the radio elements ordinarily used except some very long lived ones

At the Commissariat of Atomic Energy we plan to make a bigger cyclotron and a pile of bigger energy which will give us practically all the artificial radio elements needed in France in the following years

From the shed where Pierre and Marie Curie discovered polonium and radium the preparation of radio-elements have passed to the big scale laboratory work and now to the industrial scale There is no doubt that this new industry will become more and more important for applied research and for therapeutics

Notes and News

OBITUARY

Sailendra Nath Ghosh (1892—1949)

On Sunday the 18th December 1949 passed away Sree Sailendra Nath Ghosh after a protracted illness of about 3 months Born in Khulna on 3rd Nov 1892 Sree Ghosh took his M Sc degree in physics from the Presidency College Calcutta in 1915 standing first in the First Class His brilliant career attracted the attention of the late Sir Asutosh Mookerjee who was then reorganising the Post Graduate Department of the Calcutta University Ghosh was one of the few young men whose enthusiasm made it possible for the University to start the Post Graduate Department of Physics at 92 Upper Circular Road during the first World War He helped Sir Asutosh in his search for suitable teachers and necessary apparatus He was appointed a University Lecturer and was awarded a scholarship for study abroad However, Ghosh s connection with the Revolutionary Party was detected by the Government and he had ultimately to leave the country to avoid arrest and imprisonment Ghosh fled to America at the end of 1916 and for 20 years he was engaged in propaganda work in the States for India s Freedom After a long exile of over 20 years he returned voluntarily to India in 1936 Here he took up educational work and was successively Education Officer Calcutta Corporation Principal Braja Mohan College Barisal and finally Principal of the Jagannath Intermediate College Dacca In Dacca he was a prominent figure during the days of famine and World War II and took prominent part in all public and philanthropic work He left Dacca in October 1947 and was appointed Deputy Secretary (Education) to the High Commissioner in London in June 1948 During his stay for about a year he was a friend and guide to many young men who had gone abroad in search of higher training Unfortunately his failing health interfered with his normal activities and he returned home in September 1949 He leaves behind his widow Mrs Rebecca Ghosh an American lady and a life long comrade in his struggle for freedom and two daughters Mariam and Lyla now studying in the United States of America

INDIAN SCIENCE CONGRESS

The thirty seventh meeting of the Indian Science Congress Association was held at Poona from January 2 7 last Prof P C Mahalanobis F R S presided The congress was attended by over 5000 delegates from all over India

The session was further marked by the presence of a delegation of British, French Soviet Swedish and U S A scientists* who actively participated in the proceedings of the session and later toured the different University Centres in India

At the inaugural ceremony held on January 3 last, His Excellency Raja Maharaj Singh, Governor of Bombay and Chancellor of the Poona University welcomed the members and delegates and scientists from overseas who had come to attend the session He said The history of the world and of human progress has been a continuous and ever increasing conquest of nature and the harnessing of natural processes through the medium of scientific knowledge and equipment, to ameliorate the conditions of existence and to lead us to richer and fuller lives The economic and material development of the world is largely dependent on science Basic, applied and utilitarian research is of immeasurable value for the realisation of the latent potentialities of every country To the uninitiated, scientific knowledge may appear to be dull and prosaic But, though the ornamentation and the softening influence of art cannot be dispensed with in life, it must be admitted that science remains an unfailing key to many of the mysteries of the world It is of course, painfully true that scientific knowledge is a double edged weapon It can either be a potent engine of destruction or a powerful agent in constructive progress Let us hope that the negative side will remain buried in the limbo of the Second World War and the science and its votaries will contribute to peace and ever increasing happiness and prosperity"

The Rt Hon ble Dr M R Jayakar, Vice Chancellor of the Poona University, appealed for the use of scientific knowledge in the world for the good of society Calling for mutual assistance and exchange of thoughts", Dr Jayakar said "India believes that her progress at present lies in scientific advance Because she has set foot towards giving the ordinary man a progressive life and all that it means, scientific development in the country is absolutely necessary Scientific advancement cannot be carried on in isolation It has to be carried on with mutual assistance and exchange of thought "

Inaugurating the session, Hon'ble Dr S P Mookerjee, Industry and Supply Minister, Government of India said "The annual session of the Indian Science Congress, serves as a yearly reminder to our scientists of the need for continuous dedication of scientific knowledge to the service of our motherland and of humanity at large Such self introspection is particularly necessary at this juncture of world history when the menace of an atomic warfare hangs like a darkening cloud on the minds of all thinking men and women

"An unanswered question is written across the future Is man to be the master of civilization he has created, or is he to be its victim ? Can he control the forces which he has himself let loose ? The only answer to it and the only way to counteract the threat is by a spiritual upsurge in the minds of common men and women in every country such as will compel the application of scientific knowledge towards the good of the world

'Science, like religion, cannot be bad in itself It is the purpose and the social function which such knowledge serves that makes it good or bad

'The greatest contribution that science can make to the well being of our country is by the inculcation of that attitude of mind, which for lack of a more expressive phrase is known as the scientific attitude towards life and its problem The essence of this attitude lies in an inquisitive mind, not by any means that of a narrow specialist, but of one that would ask questions and would not rest till it has found an answer to them

"Nothing in this country impedes the application of scientific knowledge to the betterment of human beings or to the promotion of our agriculture and industry more than the lack of this frame of mind The great majority of our countrymen are still victims of ignorance and prejudice are moved more often by set habits than by an objective analysis of the pros and cons of a particular course of action

"As all scientists, social workers and administrators know, it is this conventional and passive attitude that offers the greatest resistance to the adoption of new habits and ways of living, new methods and practices in agriculture and new techniques and equipment in our unorganized industries which still constitute the major field of employment to our artisans and workers

Continuing Dr Mookerjee said, "India today stands at the cross roads of history She has attained her political independence after nearly two centuries of foreign rule Millions of her population are waiting to be served and uplifted in terms of that equality of opportunity which, under the Constitution of the Republic of India, is their inherent and inalienable right It is through science and science alone that the full achievement of this goal will be rendered possible.

"The opportunities for national service which thus await the present generation of Indian scientists cannot be over emphasized They can, therefore, legitimately claim from the State unstinted support for carrying on their progressive activities.

---

* Mme Irene Joliot Curie Nobel Laureate Professor Faculty of Sciences and Director Institute du Radium, Paris France Prof (Joan) Frederic Joliot Nobel Laureate Prof , College de France French High Commissioner for Atomic Energy, Paris France
Prof J D Bernal Professor of Physics, Birkbeck College, University of London, U K
Sir Robert Robinson Nobel Laureate President, Royal Society, London, U K (accompanied by Lady Robinson)
Dr Herman Francis Mark Director, Polymer Research Institute, Brooklyn, U S A
Prof O E H Rydbeck Director, Chalmer Geophysical Observatory Gothenborg Sweden
Dr Edward Uhler Condon Director, National Bureau of Standards, Washington, U.S A
Prof. A H Compton Nobel Laureate Chancellor Washington University, U S A
Dr. D Engelhardt Director, Pavlov Physiological Institute, Moscow, U S S R
Prof Pierre Victor Auger Head, Natural Science Dept., U N E.S C.O , Director of Higher Education, Paris, France

"This support, whether coming from the State or from private sources, must not in any way curb the independence of their profession or render them subservient to the ideologies of any party or faction. Nothing is more important or sacred both from the point of view of their own work and from that of national advancement that our universities and research institutions should be allowed to grow in an atmosphere of freedom."

Addressing the "wise men and women of science", the Prime Minister, Pandit Nehru said, 'Everything we desire and work for in India requires peace and stable conditions so that we may fulfil the primary necessities of the people."

Pandit Nehru urged the foreign scientists to "inculcate a spirit of international outlook in the minds of India's youth for making them feel the international quality of science."

"Our problems," he added 'are to be tackled not with the approach of a lawyer or a classical philosopher but that which has partly a scientific and partly an engineer's approach. Our problems are to be tackled with the spirit of a man who does things himself and not sit in his office ordering people about."

Continuing the Prime Minister said that in an under developed country like India, the stress should be on the utmost economy. "Situated as we are, our basic desire is not to get entangled in the web of power politics. Frictions caused by power politics will lead to war. Everything we desire and work for in India requires peace and a calm atmosphere to strive for the development of the country so that we may fulfil the primary needs of the people."

Prof. P. C. Mahalanobis then delivered his address (See Science Congress Supplement following p. 332.)

THE INDIAN ACADEMY OF SCIENCES

The fifteenth annual meeting of the Academy was held at Bombay on December 29-31, 1949 under the presidentship of Sir C. V. Raman. Nearly 200 delegates and Fellows of the Academy attended the session.

In his presidential address Sir C. V. Raman with the aid of slides, explained his work on the diffusion of light by matter. He referred to his first experiment in 1921 on the diffusion of light rays by the molecules of gases and described the "chain of thought" which led to the discovery of the Raman Effect in 1927 (the difference in the spectra between that of the incident and scattered light beams in liquids).

Dr. Raman referred to the possible lines of future research—particularly on the scattering of light by crystals and diamonds. 'My work with diamonds has convinced me that this line of thought, if pursued with sustained enthusiasm, will greatly help us to know the complex structure of matter and the behaviour of molecules inside it," he said.

In a rapid survey of his research on the diffusion of light in gases and liquids, Dr. Raman said that the study of "an almost endless question," had opened up new avenues of thought. Since he expounded the theory of diffusion of light in gases in 1921, he had energetically continued' that line of research, culminating in his latest conclusion on the structure of crystals and diamonds.

Describing his observations on the "little story of the diamond", the distinguished physicist related how he reached the conclusions on the structure of the gem 'through theory and experiment'. The deductions arrived at theoretically had been "well substantiated" by the groups or photographs he recently took of the diffusion spectra in the diamond.

Sir C. V. Raman was re-elected *President* of the Academy for the years 1949-52.

NATIONAL CHEMICAL LABORATORY

A large gathering of foreign and Indian delegates to the Indian Science Congress Session at Poona witnessed the ceremony of the opening of the National Chemical Laboratory by the Prime Minister, Pandit Jawaharlal Nehru. The foundation stone of this laboratory was laid on April 6, 1947 by Bombay's Premier, Dr. B. G. Kher. (See *Science and Culture* 12, 533, 1947.)

In his address Pandit Nehru said there might be many things which the Government might not have done during the last two and a half years. Our critics constantly point out our sins of commissions and commissions. But one thing I am sure, we have done to a very substantial extent—and that is in the matter of scientific research and development.

He drew attention to the Government plans for opening 11 National Laboratories all over the country and said "It is exciting to imagine large numbers of young men and women going into our new laboratories and working for the advancement of the Indian people.

"I have wandered greatly in this country. I have come to the conclusion that India possesses human material of excellent quality. This material has only to be properly used.

'We want to change the old picture. Science in the past has been discouraged but now we should provide necessary opportunities to our young men and women. This was getting the highest consideration from the Government.

"The greatest problem to-day was to select the right man, tap the right available sources and draw the right type of men into scientific research work.

"The success of our efforts will depend on our ability to secure the services of competent research workers who will carry on their duties under the guidance and inspiration of senoir officers attached to the laboratory.

"Our policy must naturally be to attract the best type of Indians and if necessary to get them trained by sending them abroad. Where, however, in the interests of efficiency it is necessary for us to recruit foreign experts, we should not hesitate to do so for such limited periods as may be required.

The establishment of national laboratories of such dimension entails a huge expenditure which is not easy to provide Such laboratories however must receive generous support from industries themselves as also from private benefactors

Located on a 470 acre site in Poona the building is 600 ft wide and has over 150 rooms incuding an Auditorium Library Seminar and Sectional Laboratories Some of the rooms have been specially equipped for applied research

The Laboratory will also provide a link between the Universities and the research institutions on the one hand and Indian industries on the other

Altough the Laboratory was formally opened on the 3rd January 1950 it has been functioning in some form ever since its inception in 1940 when the Board of Scientific and Indsnstrial Research with Dr S S Bhatnagar as the Director was formed (See *Science and Culture 11* 541 1946)

INSTITUTE OF NUCLEAR PHYSICS

The Institute of Nuclear Physics Calcutta University the first of its kind in India and the foundation stone of which was laid on April 21 1948 (See *Science and Culture 13* 491 1948) was opened on January 11 last by Mme Joliot Curie H E Dr K N Katju Chancellor of the University presiding

Mme Joliot Curie said that the importance of nuclear physics for fundamental research was evident Today were known more than a thousand different sorts of atoms stable or radio active and by the study of radiations emitted in transmutation or by the radio elements they got an idea of the intimate structure of matter

The importance of nuclear physics for practical application was growing steadily Of course there was the perspective of powerful nulear reactors for atomic energy but many other utilization were already known The production of radio elements became more and more necessary for biological study and medical research most of the radio active tracers were artificial radio elements produced by transmutation Even a small scale production of these was very useful

Continuing she said The laboratory of this Institute has a cyclotron which will make it possible to study transmutation and produce radio-elements Though the laboratory is a physical one there is also a small section of chemistry and biology It seems probable that this section will be insufficient and that Prof M N Saha will have to work in collaboration with other chemical or biological laboratories for the use of radioactive tracer

The fact that the Institute has a gram of radium is also very important It may be used to produce small amounts of artificial radio elements for tracer work and it is also useful for many physical experiments

CHITTARANJAN CANCER HOSPITAL

The Chittaranjan Cancer Hospital was also opened in Calcutta by Mme. Joliot Curie on January 12 last The foundation stone of this hospital was laid on June 5 1948 (See *Science and Culture 14* 72 1948) Dr B C Roy Chief Minister Government of West Bengal presided

Opening the hospital Mme Joliot-Curie said that since the first use of radium for the therapeutics of cancer which was made in France a few years after the discovery of radium many big centres had grown for the treatment of the disease by radiation It was a great pleasure for her to see the birth of a big medical institution for cancer treatment in India

Some of the diseases with which India was confronted were specially frequent or dangerous in tropical countries Cancer was not a tropical disease but occurred frequently everywhere It seemed to her that India had many superficial cancers which were among those that would be cured relatively well by the use of radium or X ray The work of the Cancer Hospital should therefore be particularly fruitful

Continuing she said that big medical institutions were useful not only for routine medical work but they must also be centres of medical research

In a centre for the treatment of cancer even simple statistics of the origin of cases and their treatment could be the basis of important medical progress Dr Khunalkar of Bombay had shown that many of cancers of skin or tongue were due to permanent irritation resulting from particular ways of living and could be easily avoided

Comparison of the statistics of the nature of cancer in a tropical country whose conditions of life were different from those in Europe and America could help to throw light on the origin of cancer and perhaps lead to means of prevention of the disease

Mme Joliot Curie hoped the Cancer Hospital would devote some of its activity to the research essential for the progress of therapeutics and of pure science

She went round the wards and departments of the Cancer Hospital and showed particular interest in the million volt X ray unit there

Mme Joliot Curie later laid the foundation stone of Nurse s Home of Chittaranjan *Seva Sadan* for the construction of which Dr N R Dhar of Allahabad donated a sum of Rs 1 00 000

NATIONAL PHYSICAL LABORATORY

A large and distinguished gathering including a number of foreign scientists watched the opening of the National Physical Laboratory at New Delhi by the Deputy Prime Minister Sarder Patel on January 21 last H E Sri C Rajagopalachari Governor General of India presided

Opening the laboratory the foundation stone of which was laid on January 4 1947 (See *Science and Culture 12* 382 1947) Sarder Patel said ' Ever since his evolution the human being has been used to pilfering the secrets of nature and applying the knowledge so gained to his own practical use Scientific research through the ages has thus been his long expedition into the innermost recesses of natural forces and phenomena and the utilitarian advantage has come to him through the urge for harnessing these forces in the service of mankind

'In his relentless pursuit of practical science however, the scientist has always come into conflict with the spiritualist and the man of religion The latter has always regarded the scientist as the destroyer of spiritual values who has brought humanity from an ethereal heaven to the very nadir of degeneration

My mind also turns to the question how far in its actual results this laboratory will serve to relieve this and the further generations of the ills to which human flesh is heir

'I ask my distinguished audience whether science in its quest for nature s secrets is going to advance the human race towards its goal of eternal happiness or whether it will open a veritable Pandora's Box of evil forces for the destruction of mankind

It is my earnest and sincere prayer that this laboratory and the distinguished band of research workers will provide a positive answer to this problem and an inspiration to their fellow scientists in other parts of the world

INDIAN PHYSICAL SOCIETY

A symposium on Crystal Structure and Crystal Physics was held on January 14 1950 at the Lecture Hall of the Indian Association for the Cultivation of Science Calcutta Dr D M Bose Director Bose Institute and Vice president of the Society was in the chair

Dr K Das Gupta described the results of his studies of the soft X ray spectra of crystals He reported that the energy states of valence electrons of several oxides SiC mica and various alkali halides were found out from measurements of soft X ray emission spectra and the positions of the vacant band in the insulators determined For ferrous alloys Pauling s empirical ideas about 3d levels in iron group alloys and compounds were verified Heat of formations of various compounds and alloys also conformed to X ray data

Sri H N Bose spoke on the luminescence of crystals excited by X rays and cathode rays In the case of pure and activated alkali halide crystals emission due to pure matrix was obtained A method of determining the trap depths from thermo luminescence data was developed

Prof S C Sirkar and B M Bishui described their results of investigation which indicated that strain in diamonds was not primarily responsible for fluorescence but that some impurities entrapped in strained regions gave rise to the energy levels responsible for fluorescence In some pure crystals the strain as shown by streaky birefringence was of large magnitude, but fluorescence was absent

Dr A Bose and S C Mitra presented the results of their measurements that showed that between the temperature range of 80°K and about 400°K the principal magnetic axes of the crystals of monoclinic Tutton salts of nickel and copper changed their orientations considerably and the anisotropies tended to vanish as the transition temperatures of the salts were approached These results were explained by considering the relative rotation of the ionic octahedral groups in the unit cell

Prof J D Bernal presented the results of some of the investigations carried out recently in London He mentioned the recent developments in the studies of the diffuse scattering whereby the various elastic constants of a single crystal could be determined He also described the results of structure determinations of some of the large molecular crystals such as virus and protein X ray determinations of the structures of tricalcium silicate crystals and alite led to an understanding of the mechanism of setting of cements Prof Bernal also mentioned a new development in the design of X ray tube in which the cathode beam was focussed on the anticathode to an extremely fine focus This eliminated the use of slit in the diffraction camera and so even with micro ampere order of X ray tube current intense powder photographs were obtained He reported that the construction of an electronic counter was in progress for speedy carrying out of fourier synthesis for crystal structure work

Prof H Mark mentioned the recent developments of X ray diffraction work at Brooklyn He described a modification of the principle of the double crystal spectrometer by which study of scattering of monochromatic X rays at extremely small angle was made possible and interesting long range periodicities in fibrous materials were observed The structure of the interesting compound cyclo tetracene was also discussed

Sri B S Basak discussed the inequalities of the c c bond lengths in phenanthrene crystal as obtained by him from a fourier synthesis of this crystal

Prof K Banerjee C R Bose and M N Dutta discussed the sharp extra spots appearing in the Laue photographs of phloroglucine dihydrate The sharpness of the fourier transforms and other characteristic features showed that they were not of thermal origin or due to ordinary crystal imperfections

MINING METALLURGICAL AND GEOLOGICAL INSTITUTE OF INDIA

The Annual Meeting of the Institute was held in Calcutta on December 27 1949 at the Royal Asiatic Society of Bengal 1 Park Street Calcutta Mr L J Barraclongh presided In his presidential address Mr Barraclough pleaded for the establishment of an adequate number of mining schools and provision for post-graduate practical training in mining in the country

Describing the part the Institute could play in furthering the industrial development of this potentially rich and powerful country he regretted the dearth of qualified Indian mining engineers

Although facilities for technical education in advanced mining were available at Dhanbad and Banaras there was a dearth of mining schools at which officials subordinate to the manager might be trained

India needed cheap coal which could not be supplied if the output per manshift remained at $\frac{1}{3}$ ton Mechanization could improve the present condition provided trained supervisors were available who could handle both machines and men

Referring to safety measures he said that the accident rate in Indian mines had shown a progressive decline during the past few years and it was now about the lowest in the world

At the annual dinner of the Institute Mr A J Elkins President of the Bengal Chamber of Commerce said It is vital the colliery workers must realize that any further improvement in their lot can only come from increased individual productivity but in this context their performance over the last decade has been far from encouraging

He pointed out that against a 60% increase in the *average daily number of workers in the industry* there had been only a 6% increase in the tonnage of coal produced

In India wages in the coal industry account for anything between 60% and 80% of the total cost of production In other industries jute for example only 30% of the cost of the finished article is reflected in the wage bill

Reviewing the position of the industry before and during the war he said that the emphasis should now be on consolidating the position in such a way as to ensure for the future a good standard of technical efficiency coupled with increased individual productivity

Mr Elkins then referred to the gold mining industry and said that the Gold Duty Act of Mysore had so gravely undermined the industry that its very existence was threatened He hoped that there would be scope for increased production of gold in India

Dr W D West Director of the Geological Survey of India referred to metals such as lead zinc copper and to some extent aluminium—important both for industry and for strategic purposes—which India had largely to import at a cost of nearly Rs 15 crores a year

Promising results had been obtained from the exploration of the ancient lead zinc mines in Mewar State Preliminary investigations into the deposits of copper in Alwar and Jaipur States had also been made

There were thus hopeful possibilities in regard to those metals but their exploitation by private enterprise was hanging fire There was the difficulty of raising capital There was also a dearth of experienced personnel

He suggested that either the Government should bear the risk and open up the deposits or facilities should be granted to foreign companies to enter the field on terms not detrimental to the interests of India

The following award and prizes were announced *Government of India Prize of Rs 500 and the Institute Gold Medal* to Mr L J Barraclough for his paper on Hydraulic stowing in India a record of general observations *the Institute Silver Medal* to Dr J W Whitaker for his paper on Densities of Indian Coals No 1 and *the Institute Bronze Medal* to Dr M S Krishnan for his paper on Coal in the Godavari Valley Madras Presidency

The following were elected Office bearers of the Institute for 1949 50

President—Mr I J Barraclough *Honorary Treasurer*—Mr V P Sondhi *Editor of Transactions*—Dr M S Krishnan *Honorary Secretary*—Dr P K Ghosh

RADIOACTIVE COBALT FOR CANCER

Radioactive cobalt (C^{60}) which has been under investigation for several years as a possible substitute for radium in the treatment of cancer is now being used experimentally for the treatment of selected types of the disease at the Ohio State University School of Medicine It can be produced in nuclear reactors Whereas radium costs between $ 15 000 and $ 20 000 per oz radiocobalt is available to cancer research departments at a minium charge for handling Moreover somewhat better results are anticipated with its use as the gamma rays from cobalt made radioactive in the pile are said to have greater activity (*The Chemical Age* December 10 1949)

UNITS OF RADIOACTIVITY

A joint committee of the Divisions of Chemistry and Chemical Technology and of Mathematical and Physical sciences of the National Research Council in U S A has adopted certain recommendations regarding standards and units of radioactivity These recommendations it is pointed out effectively divorce the curie from the disintegration rate of radium by assigning to the former an arbitrary magnitude ($3 7 \times 10^{10}$ dis/sec) approximately equal to the distintegration rate of radium This arbitrary figure is therefore not influenced by any future revisions of the generally accepted distintegration rate of radium This changes slightly the meaning of the curie when applied to radium For example 1 curie of radon is no longer on the basis of these recommendations the amount in equilibrium with 1 gram of radium but is the amount undergoing $3 7 \times 10^{10}$ disintegrations per second Similarly 1 mg and 1 mc of radium are no longer rigorously synonymous This distinction has a number of precedents in physics For example the international ampere now abolished was not quite equal to the absolute ampere and the angstrom unit is nearly but not quite equal to 1000 *X* units

The Curie should be defined as that quantity of any radioactive species (radioisotope) undergoing exactly $3 700 \times 10^{10}$ disintegrations per second The *rutherford* should be defined as that quantity of any radioactive species (radioisotope) undergoing 10^{6} disintegrations per second For the quantitative compari son of radioactive sources emitting gamma rays, for which disintegration rates cannot be determined, *roentgen per hour at one meter* (rhm) is recommended The recommendation of this latter unit is a practical step to insure that, by its use, gamma ray measurements are so made with instruments and under such conditions that measurements on a given isotope made in any laboratory will be directly comparable with similar measurements made in other laboratories This will result if the procedures used comply with the definition of the unit, that is, a source is 1 rhm if it produces 1 roentgen per hour at a distance of 1 meter

These recommendations have been submitted to the Joint Commission on Standards, Units and Constants of Radio activity of the International Unions of Chemistry and Physics for International agreement (*Science*, November 18, 1949)

AUSTRALIA S SNOWY RIVER SCHEME

The Snowy River, with its tributaries, drains 700 square miles of the Eastern Australian Alps most of which are covered with snow from May to November Rising at the foot of Mt Koscinsko in New South Wales, the Snowy eventually enters the ocean near Orbost in Victoria The waters of the Snowy fall 7,000 feet in 300 miles

The most ambitious hydro electric development scheme ever conceived in Australia, is to be implemented soon in the Snowy The scheme is a gigantic one and is estimated to cost £200,000,000 over a constructional period of 25 to 30 years The scheme will permit the development of 1 720 000 Kw of hydroelectricity This power output is equivalent to that obtainable form 4,000 000 tons of black coal annually, which is just one third the existing annual black coal output of Australia The scheme has been divided into three parts

(1) Tumut River development, by diversion to it of (*a*) slightly over one quarter of the Snowy head waters (235,000 acre feet annually) from the Eucumbene (a tributary of the Snowy,) (*b*) upper Murrumbidgee waters, (*c*) about 330 000 acre feet annually from the Tooma River, a tributary of the Murray These waters will be used for power development of about 750,000 Kw in the Tumut Valley and thence into the Murrumbidgee for irrigation purposes

(2) To compensate for the diversion of water from the Tooma (a tributary of the Murray) to the Tumut (a tributary of the Murrumbidgee), 330,000 acre feet annualy will be diverted from the Snowy to the Murray to develop hydroelectricity on its way through a series of tunnels

(3) Harnessing the upper waters of the Murray River above the existing Hume Reservoir by the construction of a large dam on a site yet to be decided for the purposes of generating hydroelectricity (*Water and Water Engineering*, December 1949).

SURVEY OF INDIA

'General report of the Survey of India for the year 1946 47' published in 1949, indicates that the work of the department at that period was not altogether satisfactory During the war the main effort of the department has been directed to large scale surveys for utilitarian purposes such as dam sites and areas for irrigation The only noteworthy work of the survey is with *Manganese Reef* The existence of a manganese reef in the Parsoda area (Nagpur C P), located in 1940 41 by observations with a Gradiometer, was confirmed in January 1947 through observations with magnetic variometers The activities of the department was chiefly confined to carrying out routine work and minor survey work for maps for military purposes The results of magnetic observations were utilized to prepare a chart of magnetic declinations for 1946 This chart covers the area bounded by latitudes 60 N to 60°S and longitudes 40°E to 168°E

It is now proposed to establish a net work of gravimeter stations at roughly a 10 mile interval throughout the extent of India Programmes for geodetic operations such as the levelling of high precision of about 15 800 miles from Bombay, gravity observations at about 30,000 stations with Gravimeters, and magnetic observations have been drawn up but the work so far carried out is not worth mentioning

It is hoped that the department has now started a serious survey work to meet the frequent demands of data for the various irrigation and other projects

NEW FELLOWS OF THE NATIONAL INSTITUTE OF SCIENCES OF INDIA

The following were duly elected as *Ordinary Fellows* of the Institute, at the last Annual General Meeting held at Poona on January 1, 1950

Dr D P Antia Development Officer, Ministry of Industry and Supply Government of India, New Delhi, distinguished for his work in metallurgy

Dr F C Auluck Reader in Physics University of Delhi distinguished for his researches in the theory of numbers, statistical thermodynamics and quantum statistics

Dr P L Bhatnagar Reader in Mathematics, University of Delhi and Head of the Department of Mathematics St Stephen s College Delhi distinguished for his work on the origin of solar system and the theory of cepheid variable stars

Dr K Biswas in charge of duties of Director at the Herbarium Royal Botanic Gardens, Calcutta, distinguished for his work on algae, systematic botany and ecology

Sri J P Bose, Officer in Charge Department of Biochemistry and Diabetes, School of Tropical Medicine, Calcutta, distinguished for his researches in the treatment of diabetes.

Prof R N Chaudhuri, Professor of Tropical Medicine, School of Tropical Medicine, Calcutta, distinguished for researches in various medical problems, such as epidemic dropsy, gastric acidity, malaria, enteric fever, sprue, pulmonary amoebiasis, hypoprotenaemia etc

Dr V M Ghatage, Assistant Professor of Aeronautical Engineering, Indian Institute of Science, Bangalore, distinguished for his researches on problems of aerodynamics

Dr H Gupta, Senior Lecturer in Mathematics, Government College Hoshiarpur, distinguished for his work on various mathematical problems

Dr T J Job, Chief Research Officer, Central Inland Fisheries Research Station, Barrackpore, West Bengal, distinguished for his work on the biology of Indian fishes and their bearing on the biological control of certain tropical diseases

Prof R S Krishnan, Professor of Physics, Indian Institute of Science, Bangalore distinguished for his work on colloid optics, light scattering, spectroscopy, Raman effect X rays and nuclear physics

Prof M C Nath, Chitnavis Professor and Head of the Department of Biochemistry, Nagpur University, Nagpur, distinguished for his work on vitamins, steroles and hormones, nutrition and proteolytic enzymes, and a new anti diabetic compound

Dr H N Ray, Research Officer, Indian Veterinary Research Institute Mukteswar Kumaun, distinguished for his researches in the field of protozoology

Dr M R Sahni, Superintending Geologist, Geological Survey of India, Calcutta, distinguished for his work in the field of Indian geology

Dr A Sreenivasan, Lecturer in Food and Drugs, Department of Chemical Technology, University of Bombay, Bombay, distinguished for his work on chemistry of food and nutrition, crop nutrition, soil science and analytical chemistry

Dr R S Vasudeva, Plant Pathologist, Indian Agricultural Research Institute, New Delhi distinguished for his work on crop diseases

The following distinguished foreign scientists were duly elected *Honorary Fellows* of the Institute

Prof P Debye, Professor of Chemistry, Cornell University, Ithaca New York, U S A

Prof M Von Sane, Professor of Theoretical physics, University of Berlin, Germany

Prof M Seigbahn, Professor of Physics, University of Uppsala, Sweden

Prof E Schrodinger, Professor of Physics, Institute for Advanced Studies, Dublin, Eire

FOREIGN SCIENTISTS AT THE SCIENCE ASSOCIATION

The Indian Association for the Cultivation of Science had a crowded programme for the distiuguished foreign scientists during their visit to the city in the second and third week of January The Association had already established scientific relation with some of these scientists by awarding or proposing to award scientific honours and distinctions in the form of medals and professorship

Sir Robert Robinson, the President of the Royal Society, was awarded the Association's *Bimala Churn Law Gold Medal* for 1945 in the beginning of 1948 The award is made for outstanding contributions in the domain of science in general, including medicine Previous recipients were Dr Albert Einstein and Sir Henry H Dale Sir Robert seized the present opportunity of his visiting this country to address the Association on January 11 on 'Anthocyanin Pigment', a subject on which he has made significant contributions Demonstrated with exciting experiments on the extracts of red, crimson, brick and violet coloured roses, dahlias and other richly coloured flowers, his lecture was profoundly enjoyed by all who packed the spacious Lecture Theatre Referring to the award, Sir Robert said that he considered it as a treasured possession and regarded it as a token of his friendly relation with Indian chemists

The Association had been expecting Madame Irène Curie to whom the award of the *Joy Kissen Mookerjee Gold Medal* was proposed in 1948 By awarding the medal to Madame Curie on Thursday, January 12, 1950, the Association added another illustrious name to the list of distinguished scientists which included, among others, late Sir James H Jeans, Prof Robert R Millikan, late Prof F W Aston, Dr Harlow Shapley and Dr Arthur E Morgan In course of her 80 minute lecture, on the applications of artificial radio activity, the full text of which appears elsewhere in this issue, Madame Curie referred to the possibility of the use of atomic power for peaceful purposes She concluded the lecture by showing a series of slides on the poor laboratory conditions under which her parents, Marie and Pierre Curie worked and the present big laboratories and establishments of the French Atomic Energy Commission of which her husband Prof Fréderic Joliot is the head Among those present was Prof Joliot who also addressed the meeting

Dr Herman F Mark, Director, Polymer esearch Institute, Polytechnic Institute of Brooklyn, Brooklyn, N Y, delivered a course of three lectures on January 12, 13, and 14, as *Coochbehar Professor* of the Association for 1943, on 'Progress in the Chemistry of Macro-Molecules' He introduced the subject with remarks on the special properties which large molecular weight imparts upon substance and then enumerated the chemical reactions which led to formation of polymers from simple substances like ethylene, styrene etc He showed how an intimate knowledge and careful kinetic analysis of the various steps of the process of addition polymerization gave clue to industrial developments of high polymeric resins of better class He next took up the behaviour of large molecules in solution and showed how a study of the properties of solutions of polymeric substances led to valuable information about their size and shape. He also remarked that the study of such properties gave useful data about the use of plasticizers in conjunction with high polymeric resins The bulk properties of high polymeric substances were then dealt with High polymeric substances, he observed, can exist in three forms, *viz*, fibre, plastic and rubber Whereas in fibres the long chain molecules are to a considerable extent organized and oriented, in rubbers they are in their highest entropy state and fairly completely disorganized The plastic state represents an intermediate situation

ANNOUNCEMENTS

Dr H J Bhabha Director Tata Institute of Fundamental Research, Bombay was duly elected *General President* of the Indian Science Congress Session to be held at Calcutta from January 2 7 1951

The following were elected Sectional Presidents *Mathematics*—Dr C Racine (Madras) *Statistics*—Sri A R Sinha (Calcutta) *Physics*—Dr C S Venkateswaran (*Trivandrum*) *Chemistry*—Dr R C Shah (Bombay), *Geology & Geography*—Dr J B Auden (Calcutta), *Botany*—Dr B B Mundkur (New Delhi), *Zoology & Entomology*—Dr N C Chatterjee (Dehra Dun), *Anthropology & Archaeology*—Dr S S Sarkar (Calcutta), *Medical and Veterinary Sciences*—Dr G Sankaran (Calcutta), *Agricultural Sciences*—Dr J K Basu (Sholapur), *Physiology*—Dr M Banerjee (Calcutta) *Psychology & Educational Sciences*—Dr S K Bose (Calcutta) *Engineering and Metallurgy*—Prof M S Thacker (Bangalore)

The Executive Committee of the Indian Science Congress for the year 1950 51 will be constituted as follows —*President* Prof P C Mahalanobis *President-elect*—Dr H J Bhabha, *Treasurer*—Prof K N Bagchi *General Secretaries*—Dr B Mukerji and Dr B Sanjiva Rao

Members (elected by the General Committee)—Prof S N Bose, Calcutta Dr D S Kothari, New Delhi Sri B K Sarkar Calcutta Dr K N Bahl, Lucknow, Dr P K Ghosh, Calcutta, Prof P C Guha Bangalore Prof S K Mitra, Calcutta, Dr B C Kundu, Hooghly Dr B N Prasad Patna Prof L. Rama Rao, Bangalore

At the fifteenth Annual General meeting of the National Institute of Sciences of India held at Poona on January 2, 1950 under the presidentship of Prof S N Bose, the following were duly elected as office bearers and members of the Council of the Institute for the year 1950 *President* Prof S N Bose (Calcutta), *Vice Presidents* Prof A C Banerji (Allahabad), Dr K S Krishnan (Delhi), *Treasurer* Dr C G Pandit (Delhi), *Foreign Secretary* Dr J N Mukherjee (Delhi), *Secretaries* Prof D S Kothari (Delhi), Dr H S Pruthi (Delhi), *Editor of Publications* Dr S L Hora (Calcutta), *Members of Council* Dr S P Agharkar (Poona), Prof K N Bahl (Lucknow), Dr S K Banerji (Delhi), Mr S Basu (Poona), Prof S R Bose (Calcutta), Dr B C Guha (Calcutta), Prof A C Joshi (Hoshiarpur), Dr. S. Krishna (Dehra Dun), Prof R C Majumdar (Delhi), Dr H. R Mehra (Allahabad) Mr G R Paranjpe (Poona), Prof P Parija (Banaras) Dr L A Ramdas (Poona), Mr J M Sen (Calcutta) Prof N R Sen (Calcutta), Dr P V Sukhatme (Delhi) and Dr A C Ukil (Calcutta)

Dr H S Pruthi (New Delhi) and Dr S Pradhan (New Delhi) were duly elected *President* and *General Secretary* respectively of the Entomological Society of India for the year 1950 at the Annual General Meeting of the Society held at Poona on January 3 last

The following were duly elected office bearers of the Indian Ecological Society for the year 1949 at the Annual General Meeting of the Society held at Poona on January 4 last *President* Dr F R Bharucha (Bombay), *Hony General Secretary* and *Hony Treasurer* Dr B S Navalkar (Bombay) *Hony Jt Secretary* Dr T J Job (Barrackpore West Bengal)

Dr B P Pal (New Delhi) and Dr R Misra (Saugor, C P) were duly elected as *President and Hony Secretary* respectively to the Indian Botanical Society for the year 1950 at the Annual General Meeting of the Society held on January 1 last

Dr B B Mundkur (New Delhi) and Dr R Prasada were duly elected *President* (for 1950) and *Secretary—Treasurer* (for 1950 52) respectively of the Indian Phytopathological Society at the Annual Meeting of the Society held at Poona on January 3 last

Prof P Rây, Palit Professor of Chemistry of the University of Calcutta and one of the Editors of *Science and Culture*, has been invited by the Austrian Society of Microchemistry to attend the First International Michrochemical Congress to be held in Graz from July 2 to 6, 1950 The main purpose of the Congress is to assemble the microchemists of the world to mutual discussion and exchange of ideas as incentive to further achievement

Dr Walter Baukloh, formerly Prof of Metallurgy and Director of the Institute of Iron Metallurgy Technical University of Berlin (known as technische hochschule, Berlin) has joined the Bengal Engineering College, Sibpur, as Professor of Metallurgy

The Trustees of the Lady Tata Memorial Trust are offering six scholarships of Rs 250/ each per month for the year 1950 51 commencing from 1st July 1950 Applicants must be of Indian nationality and Graduates in Medicine or Science of a recognised University The Scholarships are tenable in India only and holders must undertake to work whole time under the direction of the head of a recognised research institute or laboratory on subject of scientific investigation that must have a bearing either directly or indirectly on the alleviation of human suffering from disease Candidates can obtain detailed information from the Secretary of Lady Tata Memorial Trust, Bombay House, Bruce Street, Fort, Bombay

LETTERS TO THE EDITOR

[*The Editors are not responsible for the views expressed in the letters.*]

PROPAGATION OF *PAN* (*PIPER BETLE* L) IN THE NORTHERN DISTRICTS OF THE CENTRAL PROVINCES

The 'seeds' (*beej*) or *pan* cuttings as used for the propagation of *pan* (*Piper betle*) in the southern districts of the Central Provinces have been previously reported [1,2] The seeds as used in the northern districts, *viz* , Jubbulpore, Saugor, Mandla and Hoshangabad are described in this paper

Five varieties of *pan*, *viz* *Sohagpuri Bangla*, *Desi Bangla*, *Kapuri Gangeri and Kakher* are cultivated in the northern districts *Sohagpuri Bangla* and *Desi Bangla* occupy about nine tenth of the total area under *pan* cultivation in these districts *Kapuri* and *Kakher* are grown on a very small scale in a few places only *Gangeri* is grown on a large scale in two places only, *viz*, Timarni and Seoni malwa

The seeds' are taken from one to five years old vines, usually from three years old ones A 'seed' as used in the northern districts consists either of one internode having only one leaf on it or of four internodes having four leaves on it The seeds' consisting of one internode each are taken from the middle portions of the vines, usually from the 7th to the 23rd node of a vine from tip downwards, The seeds' consisting of four internodes each are, however, often taken right from the tip to the 23rd node of a vine The 'seeds' are sown in pairs, the distance between two pairs in a row (*asti*) being 3½ to 7 inches When they are sown 3½ inches apart, for one acre of land 2,40,000 cuttings of one internode each or 46,000 cuttings of four internodes each are required The cuttings of different varieties of *pan* are sold at different rates as shown in the table given below

Variety	Average normal rate of cuttings per rupee		Total cost of cuttings per acre	
	cuttings of one inter node each	cuttings of four inter nodes each	cuttings of one inter node each	cuttings of four inter nodes each
			Rs	Rs
Sohagpuri Bangla	400	100	600	460
Desi Bangla	400	100	600	460
Kapuri	800	200	300	230
Gangeri	300	75	800	613
Kakher	600	150	400	306

In the northern districts the chick houses (*mandaps*) are constructed during the month of January or February and the *pan* cuttings are planted during the month of February or March

The method of sowing 'seeds' consisting of one internode each is called *pindi boni* In *pindi-boni* cuttings to be sown are laid in pairs along either sides (*astis*) of the ridges (*sapuds* or *sapras*) 3½ to 7 inches apart A lump of moist soil is then placed on the internodes (*gods*) of each pair of cuttings, leaving the leaves free above ground The lump of soil so placed is then strongly rammed by an egg shaped earthen hammer (*pindia*) After a ridge has been sown, it is lightly watered and then thinly covered up with dried grass which is removed during the sixth week of plantation In an eight hour day, a *bari* (*Pan* grower) can sow about 1 050 pairs of cuttings At the rate of one rupee per *bari* per day the cost of sowing one acre of land approximately amounts to Rs 115

The method of sowing 'seeds' consisting of four internodes each is called *keeched boni* In *keeched-boni* the ridges are heavily watered an hour or two before the cuttings are sown so that the soil on them may become soft and swollen The cuttings are then laid in pairs on this water soaked soil along either sides of the ridges 3½ to 7 inches apart The internodes of the cuttings are then pushed into the soil, leaving the leaves free above ground In a day a *bari* can sow about 800 pairs of cuttings At the rate of one rupee per *bari* per day, the cost of sowing one acre of land approximately amounts to Rs 30

Some times rooted vines are used as "seeds' instead of cuttings When sowing is to be done by this method, all of the old vines except those that have been marked out for sowing are uprooted and removed from the garden These rooted vines left at intervals of two feet along either rows (*astis*) are then laid and sown on the ridges just as cuttings are laid and sown

During the past few years *pindi boni* has been exclusively adopted in preference to *keeched-boni* for the propagation of *pan* in most of the centres of *pan* cultivation The merits of *pindi boni* as compared to those of *keeched boni* are briefly stated below

Pindi boni (One internode cuttings)	*Keeched boni* (Four internodes cuttings)
1 In *pindi boni* the germination of cuttings is almost cent per cent	1 In *Keeched-boni* the germination of cuttings is hardly about 75 per cent.
2 After germination almost all of the cuttings survive	2 After germination about 25 per cent of the cuttings die out
3 The roots are well developed and strike deep into the soil	3 The roots are poorly developed and remain spread just below the soil surface.
4 The stems are well developed and the leaves are large and uniformly sized	4 The internodes of the stems are comparatively much thinner as well as shorter in size The leaves are also smaller and less uniformly sized.

5 *Pan* leaves can be stored for four or five months.	5 The leaves of the same variety and age can hardly be stored for two months
6 The vines remain in good condition for five or six years.	6 The vines of the same variety begin to deteriorate after three years
7 The vines are less susceptible to the diseases In the case of foot rot disease (caused by *Phytophthora parasitica* var *piperina* Dast or *Pythium piperinum* Dast) only one vine is killed	7 The vines are more susceptible to the diseases In the case of foot rot disease all of the vines arising from the same cutting become infected and die

My thanks are due to Dr R P Asthana Mycologist to Government Central Provinces and Berar for providing facilities for the study of *pan* cultivation in the Province

K A Mahmud

Agricultural Research Institute
Nagpur 25 7 1949

---

[1] Asthana, R P and Mahmud K A *Proc Indian Acad Sci* 22 B 70 75 1945

[2] Mahmud K A *Proc Indian Acad Sci* (Under publication)

INTERNAL RESISTANCE OF AN ACCUMULATOR

The conventional method for the determination of the internal resistance of an accumulator entails the measurements of the E M F (F) of the cell on open circuit and of the terminal voltage (V) when it takes a known current I Since the internal resistance drop is small compared to E and V any small error in the measurement of E or V causes a large error in the evaluation of internal resistance This necessitates the precision measurement of E and V usually with a potentiometer As the voltages to be measured are approximately 2 volts a suitable volt box has also to be employed

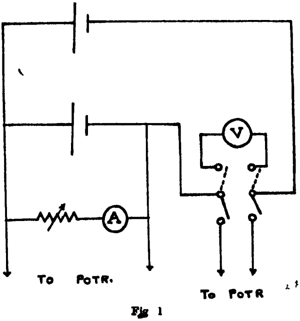


Fig 1

A = 0–5 Ammeter V = 0–100 Milli voltmeter

If two similar accumulators are connected in opposition a voltmeter connected as shown in Fig 1 will directly measure the difference in the voltages of the two If the accumulator whose internal resistance to be measured is loaded its terminal voltage will fall The difference of the voltmeter reading with the cell first on open circuit and then on load will give directly the internal resistance drop for the particular load current

As in this method a small circulating current flows through the reference battery voltmeter and the cell we have also determined the difference in voltage on open circuit and on load by means of a potentiometer since when balanced it takes no current from the cells It will be seen that the results obtained by the above two methods are practically identical confirming thereby that the small circulating current makes no difference to the result In column 5 (see table) are given the internal resistance drop determined by the conventional method All the readings were taken almost simultaneously

Table 1

Current in Amps.	Time to reach steady value in minutes	Int Resistance Drop in Mv			Internal Resistance in Milli ohms		
		Milli volt meter	Potentiometer—Differential	Potentiometer—Direct	Milli volt meter	Potentiometer—Differential	Potentiometer—Direct
0 5	15	26 5	26 8	26	53	53 8	52
1 0	10	39	39 4	39	39	39 4	39
1 5	7	42 5	43 0	42	28 3	28 7	28
2 0	7	47	47 5	45	23 5	23 7	22 5
3 0	7	50	50 5	48	16 7	16 8	16
3 5	5	57 5	58 0	54	16 4	16 0	15 5

It was observed that the internal resistance varied with time for a given current the smaller the current, the longer it takes for the internal resistance to attain the approximately steady value this time, interval being noted in column 2

If a fully charged battery is available from the milli voltmeter reading the state of charge of a second accumulator can be deduced

N C Saha
K P A Menon

Electrical Engineering Laboratory
Annamalai University, Annamalainagar
21 9 1949

TITRATION CURVES OF AMBERLITES I R 100 AND I R 4 B

The potentiometric neutralisation curves of dilute suspensions of very fine particles of the above resins revealed new features The Amberlite I R 100 which is a cation exchanger was ground in an agate mortar and pestle and the particles not settling even after 8hrs sedimentation from a depth of 10 cm were collected in N/20 HCl medium The particles thus collected in their H form were suspended in boiled conductivity water after filtering and washing free from HCl The titrations were done with dilute NaOH in pure water and in presence of 01627 N NaCl with the help of a Beckman's *p*H meter fitted with glass electrode Increased total acidity was not observed in presence of salt in the two curves which are unlike similar curves for the same commercial product obtained by Kunin[1], in this respect A depression of the initial *p*H was however observed on the addition of salt The total acidity calculated from the inflexion points is 1 97 m e per gm The strength of the suspension used for the above titrations is 1 98 gms per litre

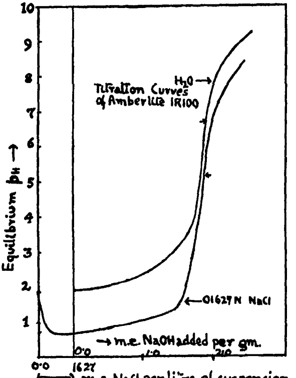


Fig 1

Amberlite I R 4B is an anion exchanger The process of obtaining the sample in its OH form for potentiometric titration is exactly the same as in the case of I R 100 only with the difference that particles not settling even after 12 hrs from a depth of 10 cms were collected in N/20 NH_4OH medium The titration curve with dilute HCl showed two inflexion points characteristic of a weak diacidic base With concentrated suspensions or suspensions of coarser materials this fine feature is difficult to obtain and was missed by Kunin[1] in his curves The two inflexion points mark two types of basic nitrogen groups in the anion exchanger probably two amine type nitrogen atoms in the same benzene ring The calculated total alkalinity is 9·91 m e per gm The strength of the resin suspension used is 0 238 gms per litre on oven dry basis at 105°C

My thanks are due to Dr S K Mukherjee for his continued interest and giving full laboratory facilities

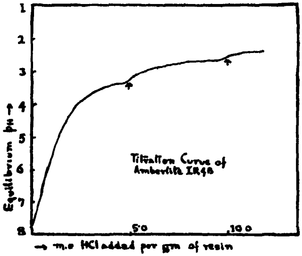


Fig 2

S L Gupta

University College of Science and Technology,
92, Upper Circular Road,
Calcutta, 21 9 1949

---

[1] Tompkins, E R *J Chem Ed*, 26, 32, 1949

THE LIMITS OF THE UPPER KHIRTHAR IN THE INDIAN REGION

Puri[1], has given a partial interpretation of certain investigations he carried out under the B O C (I C) Ltd His exposition of the subject contains certain errors, and the correlation diagram he reproduced has since been superseded by a revised version

It is suggested that any discussion of tl is subject should await the detailed publication of this work, which has been done during the past seven years in collaboration with the Geological Survey of India, for, as pointed out by Vachell[2] the whole matter of the Eocene correlation and nomenclature of the Indian sub continent had become so full of assumptions and inconsistencies that further publication on the old basis would only produce worse confusion It was, indeed, for this reason that the major work now nearing publication was undertaken

Y Nagappa

The Burmah Oil Co (India Concessions) Limited,
Digboi, Upper Assam
3-10 1949.

---

[1] Puri, H S.—*Science and Culture*, 15, 73, 1949

[2] Vachell, E. T.—*Proc 30th Ind. Sc. Congress*, IV, 6, 1943.

BUFFERING OF MEDIA FOR TETANUS TOXIN

While carrying on investigation on toxin production from *Cl tetani* it has been observed that buffering of the media with Na_2HPO_4 after final adjustment of *p*H to 7 4 7 6 is definitely useful in many cases for having higher m l d toxin and uniformity Several batches of toxin broth were inoculated with a specially isolated strain of *Cl tetani* with control media without buffer and in majority of cases buffered media produced better results Three different types of media were tried The production of toxin in each group along with a set of control being recorded in the table below The figures represent results from an average of at least three exper ments in each group

TABLE

Media	Animal used	Quantity of toxin injected	Results	
			with buffer	without buffer
1 Special media of pepsin digest broth (digest concentrated and diluted with veal infusion to contain 1% peptone)	Guinea pig	1c c of 1/10000 dilution	Animal dead within 36 60hrs	Animal dead in 84 hrs—living affected
2 Pepsin digest broth without concentration	"	"	"	"
3 Ramon media modified with adjustment of *p*H	"	"	Amimal dead in 60 hours	Animal dead on the 9th day—slight affected

From the results in the table it will be noted that buffering is definitely advantageous in the production of higher m l d toxin

Further work is in progress

ANANTALAL MISRA

Bengal Immunity Laboratory,
Baranagar, Calcutta, 26 10 1949

A NOTE ON A SIMPLIFIED TECHNIQUE FOR OBTAINING LAPSE RATE IN CUMULUS CELL WHEN ENVIRONMENT AIR IS ENTRAINED

Austin[1] developed a graphical method for obtaining the lapse rate in cumulus cell when air from environment is "entrained" in known proportions The author has developed a technique which makes the computation of the lapse rate much more easy, enabling the plotting of the lapse rate curve on the tephigram in matter of a minute In the method developed by Austin, a known proportion of environment air is allowed to mix with the cloud air at certain stages of its ascent and the resulting unsaturated air is allowed to be saturated at constant pressure by evaporation of rain water from the cloud The basis of the simplified technique developed by the author is that the entr ained" air is first allowed to be saturated by water in the cloud and so to attain its wet bulb temperature and then allowed to mix with the saturated air of the cloud If we neglect the latent heat liberated due to the small amount of condensation that takes place in the mixing of two saturated air masses the resulting temperature which is then given by the proportionate mean of the temperatures of the quantities of the two air masses can be marked off directly on the tephigram, by dividing the isobaric distance between the two temperature lines in the required proportion The wet-bulb curve requires to be plotted alongside the sounding for using this technique but the plotting of wet bulb curve on the tephigram has become a routine practice in India It has been shown that the error involved in neglecting the latent heat liberated due to the small amount of condensation that takes place as a result of mixing the two saturated air masses is negligible in actual practice and hence the technique gives sufficiently accurate results for all practical purposes

Details will be published elsewhere

S N RAY CHOUDHURI

Meteorological Office
Poona 5, 15 11 1949

[1] Austin, J M *Jour Meteorology* 5 103 107 1948

ON THE OCCURRENCE OF VELAMEN IN *EULOPHIA* R BR,

Eulophia R Br is a ground orchid which occurs from the sea-level upto 2 500 ft It is a perennial with a large conical pseudobulb The leaves are not fleshy but long and narrow *E graminea* Lindl is a species reported to occur in Travancore Chenglepet and Cuddapah in the Madras Presidency[1] It was recently collected in Nuzvid in Kistna District growing in an open rocky and dry locality on the plains

A casual study of the anatomy of the roots has revealed the occurrence of the velamen thickenings which are characteristically found in the aerial and absorbing roots of epiphytic orchids (Figs 1 & 3) Besides, the cortical cells reveal the presence of endotrophic mycorrhiza

Coulter *et al*[2] observes that the most characteristic feature of these roots the velamen is possessed by nearly all aerial roots and by almost no soil roots, except in a few forms, such as *Bletia* and *Spiranthes cernua* thus the medium seems to have a rather definite relation to the formation of the velamen"

Fleshy leaved orchids do not ordinarily develop pseudobulbs and have a very feebly developed velamen The occurrence of velamen and endotrophic mycorrhiza

(Fig 2) seem to be additional adaptations to drier habitats in land orchids

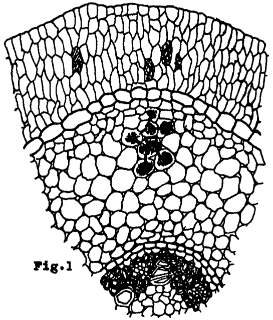


Fig.1

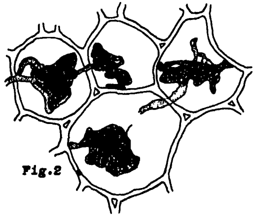


Fig.2

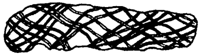


Fig.3

Fig I A t s of the root showing velamen tissue and velamen thickenings only in a few cells Fig 2 Cortical cells in the t s of root showing endotrophic mycorrhiza Fig 3 A velamen cell separated after maceration showing thickenings

Our thanks are due to Dr S K Mukherjee, Curator of the Herbarium, Royal Botanical Gardens, Sibpur, Calcutta, for identification of the material

S **Lakshminarayana**
V **Venkateswarlu**

Department of Natural Science,
Hindu College,
Masulipatam, 21-11-1949

---

[1] Gamble, J S Flora of the Presidency of Madras, part VIII, P 1435, 1928.

[2] Coulter J M, Barnes C R and Cowles, H C. A Text book of Botany, Vol III (Ecology), p 513

[3] Willis, J C A *Dictionary of the Flowering Plants and Ferns*, p 468, 1948

HYGROSCOPICITY OF JUTE FIBRE

It is well known that jute is more hygroscopic (*i e*, has a higher moisture regain value at the same temperature and humidity) than flax and hemp as well as cotton This has been variously attributed to a (*i*) greater proportion of amorphous cellulose, (*ii*) higher amount of hemicelluloses (consisting of polyuronides, pentosans and hexosans), (*iii*) larger number of free hydrophilic OH groups (*i e*, without hydrogen bonding) in holocellulose components (indicating a shorter chain length) and also in lignin, due to a higher percentage present in the fibre, etc

The moisture regain (absorption) values of alpha-cellulose (prepared with 17 5% NaOH from chlorite holocellulose) as well as hemicellulose (extracted from chlorite holocellulose with 9 3% (W/W) NaOH and precipitated from the extract with 50% (V/V) alcohol after acidification) obtained from the same jute fibre, have recently been determined in these Laboratories, under similar conditions at practically the same temperature but four different R H The results are shown below, the corresponding figures for the raw fibre are also given for comparison It will be observed that the isolated hemicellulose has a much higher moisture regain value than raw jute or alpha cellulose which is the least hygroscopic of all

Moisture Regain (absorption) Values at 68°F

%Relative Humidity	58 3	70 4	80 5	97 5
Alpha cellulose	8 3	9 7	11 7	24 6
Raw Jute	11 4	14 3	16 5	—
Hemicellulose	18 6	23 4	29 9	111 7

The hemicellulose is an amorphous, white powder, it represents approximately 50% of the total hemicelluloses present in jute fibre, and appears to consist of anhydro xylose units combined with a methoxy uronic acid Results of its detailed study will be shortly published elsewhere

Ignoring the effect of probable modification of the hemicellulose, during isolation, on its moisture regain value, it seems reasonable to conclude that it is responsible, partly at least, for the higher hygroscopicity of the fibre in as much as lignin separated from jute has but little affinity for moisture These results lend support to the views of Sen and Hermans[1] as well as Macmillan, Mukherjee and Sen[2]

P B **Sarkar**
A K. **Mazumder**

Technological Research Laboratories,
Indian Central Jute Committee,
Regent Park, Calcutta 33
1-12-1949

[1] Sen & Hermans, *Nature*, *164*, 628, 1949

[2] Macmillan, Mukherjee & Sen, *J Text, Inst* *37*, T 13, 1946.

CHEMICAL INVESTIGATION OF THE BARK OF *PRUNUS NEPALENSIS*

Two crystalline products (A) (m p 248-49°, yield 0 07%), fine needles, and (B) (m p 275-76°, yield 0 02%, (plates) have been isolated from the bark of *Prunus nepalensis*, collected from Darjeeling

(A), m p , 248 49° (Found C, 84 7%, H, 11 87% Molecular weight by Rast's method, 456 $C_{33}H_{56}O$ requires C, 84 61%, H, 11 9% and M W 468)

It is insoluble in water and ether, sparingly soluble in methyl and ethyl alcohols, readily soluble in benzene, chloroform and in warm ethyl acetate and warm glacial acetic acid It responds to Liebermann Burchard reaction and Salkowskis reaction

(B), m p 275 76° (Found C, 84 32%, H, 12 07%, Molecular weight by Rast's method 432 $C_{31}H_{54}O$ requires C, 84 16%, H 12 21% and M W 442)

It is insoluble in water, ether, ethyl alcohol and methyl alcohol , soluble in benzene boiling choloroform and ethyl acetate and also in warm glacial acetic acid It responds to Liebermann Burchard reaction and Salkowskis' reaction

The powdered bark of *Prunus nepalensis* (600 g) was extracted in a Soxhlet with ether for 12 hours The ether was recovered and the crude crystalline product (0 6 g) was crystallized from hot chloroform (4 times) as plates (m p 275 76°) It was re crystallized from ethyl acetate The chloroform solution on concentration deposited a further crop of crystals, m p , 275 76° (total yield 0 1 g) Chloroform was evaporated off from the mother liquor and the solid obtained was crystallized from hot ethyl acetate as bunches of needles, m p 248 49° (yield 0 4 g) By repeated crystallization from different solvents (chloro form, ethyl acetate , about 8 10 times), the m p remains unaltered

Further work is in progress

D CHAKRAVARTI
S A MOMEN

Department of Chemistry,
University College of Science and Technology,
Calcutta, 7 12 1949

A NOTE ON THE DIFFERENTIAL EQUATION OF THE CLUSIUS COLUMN FOR SEPARATION OF ISOTOPES

The theory of the operation of the ' separating column" of Clusius and Dickel has been worked out by a number of authors The various treatments, though they differ somewhat, lead ultimately to the same differential equation

$$Mc_{t'} = -H(1-2c)c_{x'} + Kc_{x'x'} \, * \qquad (1)$$

where c is the fractional number density of the molecules of the lighter isotope

x' is the height of any cross-section of the column from its lower end,

t' is the time in sec ,

and partial differentiation is denoted by a subscript

Eq (1) is the basic equation of the separating column Its solution subject to the appropriate boundary conditions gives the concentration distribution along the column as a function of time

Eq (1) is nonlinear, and uptil now the solution of the equation has been obtained only after linearisation which is applicable to the case when c is small compared to unity The results of Debye, Bardeen and others all relate to this case

It is found, however, that Eq (1) can be completely solved subject to the appropriate boundary conditions A simple transformation of the independent variables brings it to the form

$$c_t = -(1-2c)c_x + c_{xx}$$

This equation can be reduced to the linear form by the substitution

$$c = \tfrac{1}{2} + w_x/w$$

where w is a function of x and t, and further satisfies the well known diffusion equation

$$w_{xx} = w_t$$

The substitution proposed simplifies also the initial and the boundary conditions, and complete solutions for the usual cases may be obtained For instance, when the column is closed at the upper end and connected to a reservoir of infinite capacity at the lower end, the boundary conditions reduce to

$$-w_x \quad au, \qquad \text{at} \quad x \quad 0$$
$$w_{xx} = \tfrac{1}{4}w, \qquad \text{at} \quad x \quad l$$

while the initial condition becomes

$$w(x,0) = e^{-ax}, \qquad \text{at } t=0$$

where $a = \tfrac{1}{2} - c_0$

c_0 is the constant initial concentration and lK/H is the length of the column

The complete solution for this case is

$$w(x,t) = \exp\,[-al + t/4]\,[c_0 e^{x/2} + (1-c_0)e^{-x/2}]/$$
$$[c_0 e^{l/2} + (1-c_0)e^{-l/2}] + (\tfrac{1}{4} - a^2) 8 S_n \exp\,[-al + S_n^2 t]$$
$$\text{Sinh } S_n(l-x)/[a(1-4S_n^2)\{1 - al(1 - S_n^2/a^2)\}]$$

in which the second term is summed over the roots S_n of the equation

$$\tanh \; S_n l \; -S_n/a$$

with certain exceptions

The solutions for the other cases may be similarly worked out

Complete calculations will be published elsewhere

My thanks are due to Prof M N Saha, F R S for making me familiar with this newly developed subject, and for the keen interest he has taken during the progress of the work to Prof N R Sen for carefully examining the mathematical procedure , and to the National Institute of Sciences of India for the award of a fellowship

SUDHANSU DATTA MAJUMDAR
Institute of Nuclear Physics,
University College of Science and Technology,
Calcutta, 26-12-1949,

---

* For the meaning of the constants H, K and M see *Rev Mod Physics, 18*, 151—224, 1946

THE CONSTITUENTS OF *COPTIS TEETA* WALL

Coptis teeta Wall (Family *Ranunculaceae*) is commonly known in India as Mishmi teeta or bitter which points to its natural abode Mishmi hills and to its bitter taste Its rhizomes were examined long ago by Perrins[1] who obtained a large amount of a yellow coloured substance which he thought to be berberine Since then the knowledge of the constituents of this species was obscure though there is record of three *Coptis* species being completely investigated *e.g C trifolia*[2] Salis *C japonica*[3] Mak and *C occidentalis*[4] Salis.

The rhizomes of *C teeta* Wall were subjected to a chemical examination according to the method of separation of *Berberis* alkaloids[5] developed in this laboratory and they yielded an ether soluble base the so called coptine three non phenolic bases berberine (tetrahydroberberine m p 172° acetone compound of berberine m p 167 69° decomp) palmatine (tetrahydropalmatine m p 142°) and a base yet uncharacterised whose tetrahydro compound melted with decomposition at 212 13° and one phenolic base which was identified to be jatrorrhizine (B HI m p 210°)

It appears that jatrorrhizine has been reported for the first time from a species of *Coptis*

Details of the results will be published in the *Journal of the Indian Chemical Society*

The author is indebted to Dr P C Rakshit Professor and Head of the Department of Chemistry for providing laboratory facilities and to Dr R Chatterjee and Mr M P Guha for guidance and assistance

Presidency College A CHATTERJEE
Calcutta 9 1 1950

J Chem Soc 15 341 1862

Schults *J Pharm 14* (i i) 273 1884

Murayama and Shinozaki *J Pharm Soc* Japan No 530 32 1926

Mollet and Christiansen *J Amer Pharm Assoc 23* 310 1934

Chatterjee and Guha Results communicated to the American Pharmaceutical Association

---

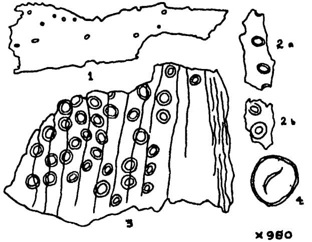
MICROFOSSILS FROM THE VINDHYANS

The Vindhyans generally regarded as pre Cambrian or Cambrian in age bears a general lithological resemblance with the Purple Sandstone Stage of the Punjab Salt Range The Purple Sandstones on micro-analysis by the authors[3 4] have yielded remnants of definite post Cambrian flora *e g* scalariform tracheids bordered and simple pitted wood elements grass like cuticles spores etc all suggestive of the presence of phylogenetically advanced vascular plants Hsü[5] however obtained negative results on microbotanical analysis of two specimens from the massive upper part of the Purple Sandstone proper near Khewra gorge

The rock at present analysed is an Olive Shale bearing the number 58/918A and comes from the locality of Nala east of Patwadh Mirzapore Dt U.P

The Olive Shale represents one of the upper beds of the Semri Series which in turn forms the lower part of the Vindhyan System This Series is very extensive and is found in the Son Valley Karauli State of Rajputana and also in the Chitor-Jhalrapatan area[6]

Vindhyans have already been reported to be fossiliferous Jones for the first time reported the presence in the Suket Shales near Rampura Central India of certain discoid fossils which were later identified by Chapman[2] as remains of primitive brachiopods and finally assigned by Sahni[11] to the family Fermoriidae According to Reed[9] if the organic nature of these fossils be confirmed we may have to put some part of the Vindhyans in the Cambrian A Pteropod genus *Hyolithes* was recorded by Rode[10] in the Vindhyans of Rohtas hills in Bihar Attention has also been drawn by Auden[1] of the occurrence of organic like forms in the Vindhyans Misra[7 8] very recently examined (*i*) sandy glauconite limestones from the Lodhwara hill and (*ii*) rocks from the Banjari quarries which come from a horizon towards the top of the Rohtas Stage He found casts of organisms without or with walls either transparent or opaque and carbonised in the one and Dasycladaceous verticillate alga with slender jointed stalk terminated by a globular sporangia in the other We have now observed from the rock specimen quoted above (*i*) carbonised woods with simple pits of variable size (Fig 1) (*ii*) bordered pits (Fig 2) (*iii*) non carbonised bordered pitted element with rays (Fig 3) and (*iv*) several monolete spores (Fig 4) The total number of microfossils so far recovered from this particular sample (collected from the surface) is 65 Similar microfragments have also been recorded from samples collected from 1 ft below the surface



The result is thus very interesting firstly because it is for the first time that microfossils of post-Cambrian vascular flora are found in the geologically known pre-Cambrian or Cambrian beds of the Vindhyans and secondly because this result support the work of the authors[3 4] on the Purple Sandstone Stage (Cambrian) of the Salt Range Punjab

Our thanks are due to the Director, Geological Survey of India for supplying us with a complete set of Vindhyan rocks, to the Burmah Oil Company (India Concessions) Ltd for financial assistance, and to Dr D M Bose, Director, Bose Research Institute for providing facilities for this investigation

A K GHOSH
A BOSE

Bose Research Institute,
Calcutta 18 1-1950

[1] Auden, J B *Mem Geol Surv Ind*, *62*, pt 2, 1933
[2] Chapman, F *Rec Geol Surv Ind*, *69*, 109, 1935
[3] Ghosh, A K Sen, J and Bose, A *Proc Ind Sci Congr*, Part III, 145, 1948
[4] Ghosh, A K and Bose, A *Proc Ind Sci Congr*, Part III, 73 and 227, 1950
[5] Hsü J *Proc Nat Acad Sci B 16* 92 1946
[6] Krishnan M S Geology of India and Burma 189 1949
[7] Misra R C *Proc Ind Sci Congr* Part III, 144, 1947
[8] Misra, R C *Curr Sci*, *18*, 438 1949
[9] Reed, F R C The Geology of the Britisth Empire, 420, 1949
[10] Rode, K P *Curr Sci 151* 247 1946
[11] Sahni, M R *Rec Geo Surv Ind* *60*, 458, 1946

BOOK REVIEWS

Fungi and Plant Disease—By B B Mundkur Macmillan & Co Ltd London, pp x+246,1949 Price 16s net

Since the publication of Butler's classical book on "Fungi and Disease in Plants for advanced students and research workers in India more than thirty years ago no attempt has so long been made for a more handy book with recent additions Dr Mundkur s new text book is equally brilliant, small but full of information brought up to date and the only one suitable for students undertaking undergraduate course of studies in Botany and Agriculture of the Indian Universities It is a pleasure to follow him from point to point

The book is well planned A brief 'Introduction to the basic facts of the structure and reproduction of fungi is followed by an excellent but not sufficiently adequate account on metabolism The next two chapters explaining the types of plant diseases and their symptoms, and methods of studying diseases are really helpful guide to students, and the one introducing to the principles of nomenclature and classification is excellent

About forty two life histories of fungi parasitic on common and important agricultural crops in India have been described under a system of classification with some general account of each of the four major groups of the fungi These life histories in general and those of rusts and smuts in particular are very well written within limited space, and brief references have been made to the symptoms they produce The last three chapters briefly deal with the bacterial and virus diseases, and the methods of control An additional short note on common wood rotting parasites and a chapter on mycological technique would have added to the usefulness of the book

The book has been profusely illustrated with neat sketches and excellent photographs

The author has used a few uncommon terms by referring to ascospores and basidiospores as sexspores (they should be more appropriately called sexually produced spores), submerged mycelium as endophytic, male gamete as antherozoid etc.

Mycologists in India are grateful to Dr Mundkur for this small volume and this will no doubt act as a stimulus to undergraduate students for taking up higher specialised courses in the subject

J S

The Principles of Structural Mechanics—By Percy J Waldram F R I C S B T Batsford Ltd, 15 North Audley Street, London W 1 cloth with dustproof cover pp xxiv+383, Third Edition 1948 Sh 18/ net

The full title of this book is the Principles of Structural Mechanics treated without the use of Higher Mathematics The latter sentence is quite significant as it gives an exact idea of the aim of this work This is not only desirable but very essential in the case of texts dealing with subjects like structural mechanics —whose width range from the simplest treatment of force and reaction to the most complicated analysis like the aerodynamic stability of suspension bridges or design of Vierendeel trusses and fixed arches

The text comprises of 36 chapters grouped into six parts The first part deals with graphic statics and contains the bulk of elementary matter needed for a clear appraisal of structural mechanics The second part comprises of discussion on beams and girders, logically followed by walls and foundations, roofs, arches and domes, and columns and shoring The last part has been specially introduced in this 3rd edition and deals with reinforced concrete In dealing with the modulus of elasticity (p 160) the author has over looked to emphasise the fact that there are three moduli corresponding to the three simple states of stress Thus Young's Modulus is for pure tension or compression, modulus of rigidity expresses the relation between the shear stress and shear strain, while Bulk modulus corresponds to volumetric strain In discussing the modulus of rupture, (p 114) the fact that it forms a part of plastic range problems and that it represents a fictitious tensile or compressive stress in the extreme fibre of a beam when rupture takes place is not very clearly brought out Similarly the use of analogy of rotating bodies to explain the radius of gyration of columns (p 313) becomes more bewildering to the beginner instead of simplifying the matter Further the omission of a reference to Poisson's Ratio one of the most common properties of a material is very surprising especially in a text which deals with elementary principles In the section on reinforced concrete the set of graphs have been drawn for stresses of 600 lbs /sq inch and 17000 lbs sq inch for concrete and steel respectively These stresses are now out of date and serve little purpose in designing members Being elementary in its outlook a bibliography for further reading would have gone a long way in helping a student to pursue advanced studies The book is clearly printed and contains a large number of illustrations To those who have no background of calculus but intend to study structural engineering principles this book can be recommended It is hoped that future editions will incorporate some of the present omissions

S A G

Engineering Optics The Principles of Optical Methods in Engineering Measurement—By K J Habell M Sc (London) F I P and Arthur Cox B Sc (Durham) M A (Cantab) F I P Sir Isaac Pitman & Sons Ltd Parker Street Kingsway London W C 2 Demy 8 vo pp xiv + 411 with numerous tables and illustrations 1948 Sh 35

The book surveys in a compact form the important and useful optical methods and instruments applicable to engineering practice and forms a model of what a text on a borderline scientific subject should and should not contain There are nine chapters in all which can be divided into essentially two parts The first part comprising of the first three chapters discusses optical theory aberrations and diffraction and light and illumination As the human eye is probably the grandest of nature's optical systems the authors have also included its description and functioning in a lucid manner This first part actually serves as a refresher course for engineers whose knowledge of optics studied in the early physics classes may have been dimmed through the passage of time

The second part comprising of the remaining six chapters and forming practically three fourths of the bulk is devoted to a survey of optical instruments like miscroscopes telescopes projectors and other miscellaneous instruments like interferometers In describing these instruments the authors have not lost sight of the fact that they are catering for engineers wishing to study optics and not physicists studying engineering inspection and control In this is also included a brief chapter on the methods of production of glass metal and graticules surface treatment and care of optical equipment

In dealing with microscopes this reviewer has failed to detect any mention of the electron miscroscope—a modern electronic apparatus now found in practically all large engineering institutions and research laboratories of manufacturing concerns. He would also have liked to see some discussion on modern search lights in the chapter on Light and Illumination as this subject has been very lightly treated from a scientific viewpoint and published literature is scarce (vide Symposium on Search lights Illuminating Engineering Society (1948) On the whole this is a very useful publication on engineering optics and can be read by all engineers who wish to know the latest advances in optical design

S K G

Viscometry—By A C Merrington B Sc Ph D, F Inst P Edward Arnold & Co London, pp 142 Price 16 sh net

This book is sure to prove a very helpful guide for one interested in viscometry It does not pretend to go into details of the theory underlying the phenomenon of viscosity but gives a very concise and yet up to date account of most of the methods available for measuring viscosity Each principal type of viscometer with its modification so far proposed is described in a separate chapter The advantage and limitations of each type is discussed at length Each chapter includes also a generous bibliography so that any one requiring a more detailed account may refer to the original papers The applications of the different methods in different industries have also been clearly illustrated In addition to the principal types of viscometers the author has also described many other methods which have been developed in some industries to measure the viscosity of very viscous materials The methods used for the determination of gases are also included in a separate chapter One would have however liked if the author had included the methods of maintaining constant air pressure during measurement with tube viscometers in order to enable one to make measurements from very low to very high pressures

P C M

Tablet Making—By Arthur Little and K A Mitchell The Northern Publishing Co Ltd 37 Victoria Street England Pp 121, Price 15 sh

The book has dealt with the subject of commercial tablet making and as such it will serve the purpose of a good handbook for making medicinal and other tablets Various phases of tablet making have been carefully and systematically explained Some photographs of hand and rotary machines and of drying mixing and granulating processes and of punches and dies are extra attractions of the book The processes of compressing coating and polishing need, however better explanations supported by requisite illustrations

H P B and *A K S*

WHY STATISTICS ?*

P C MAHALANOBIS

I naturally feel honoured at my election as General President I remember several years ago I discussed with a friend of mine at that time a member of the Executive Committee of this Association the possibility of having a separate section for statistics My friend who has been always appreciative of the importance of statistics readily agreed to have an informal talk with his colleagues A little later he informed me that there was no chance of my proposal being accepted, and with a smile told me that some of his colleagues had remarked If statistics is to have a section you may as well have a section for astrology Evidently statistics and astrology were bracketted together in the mind of many of our scientists The forecasting of future events is of course a common feature and the basis was felt to be equally unscientific And yet the section for mathematics was converted into the section for mathematics and statistics in 1942, a separate section was created for statistics in 1946 and this year a person engaged in statistical work has been elected General President I am aware I have not been accorded this honour because of my personal attainments I accept it as a mark of recognition of the growing importance of statistics

A great change has taken place in the climate of scientific and public opinion about statistics One may ask how has this change been brought about? In other words, why is importance being increasingly attached to statistics? It may be appropriate, therefore, to try to explain *Why statistics?*

Descriptive Statistics

Historically modern statistics is the result of the fusion of two originally distinct disciplines—one primarily descriptive, concerned with the collection of data, the other essentially analytic, associated with the concepts of chance and probability From time immemorial men must have been compiling information for peace and war Statistics is in this sense *as old as statecraft*[1] At each upsurge of social and political development or during war there is a rapid growth and expansion of statistical practice I shall give three examples from my own country

Arthasastra of Kautilya 3rd Century B C

The *Arthaśāstra* of Kautilya[2] claims to date from the period 321 296 B C that is the Maurya period which reached its peak in the time of the great Asoka It contains a detailed description for the conduct of agricultural population and economic censuses in villages as well as in cities and towns on a scale which is rare in any country even at the present time The detailed description of contemporary industrial and commercial practice points to a highly developed statistical system In Chapter XXXV (p 158) instructions are given about the classification of villages Specific directions are also given for a detailed census of land and field (p 158)

> It is the duty of Gopa village accountant to attend to the accounts of five or ten villages as ordered by the Collector General
>
> By setting up boundaries to villages by numbering plots of grounds as cultivated uncultivated plains wet lands gardens vegetable gardens fences (vata) forests altars temples of gods irrigation works cremation grounds feeding houses (sattra) places where water is freely supplied to travellers (prapa) places of pilgrimage pasture grounds and roads and thereby fixing the boundaries of various villages of fields of forests and of roads he shall register gifts sales charities and remission of taxes regarding fields
>
> ' Also having numbered the houses as tax paying

---

* **Address of the General President at the 37th Session of the Indian Science Congress held at Poona on January 2—8 1950**

[1] Harald Westergaard noted Etymologists may find the root of the word statistics in the Italian word *stato* and a *statista* would thus be a man who had to do with the affairs of the State Statistics would consequently mean a collection of facts which might be of interest to a statesman whether they were given in the form of numerical observation or not (*Contributions to the History of Statistics* London 1932 p 2)

[2] **Translated by Dr R Shamasastry 3rd edition Wesleyan Mission Press Mysore 1929**

or non taxpaying, he shall not only register the total number of the inhabitants of all the four castes in each village, but also keep an account of the exact number of cultivators, cowherds, merchants, artisans, labourers, slaves, and biped and quadruped animals, fixing at the same time the amount of gold, free labour, toll, and fines that can be collected from it (each house) "

In Chapter XXXVI (p 160) similar instructions are given about the statistics of the Capital City (p 160)

> "A gopa shall keep the accounts of ten house holds twenty households, or forty households He shall not only know the caste, gotra, the name, and occupation of both men and women in those households, but also ascertain their income and expenditure "

One striking feature in the *Arthaśāstra* is the emphasis on the need of checking and verification by independent agents working in secret without the knowledge of the original enumerators (Chapter XXXV, p 159)

> "Spies, under the disguise of householders (grhapatika, cultivators), who shall be deputed by the collector general for espionage, shall ascertain the validity of the accounts (of the village and district officers) regarding the fields, houses and families of each village—the area and output of produce regarding fields, right of ownership and remission of taxes with regard to houses and the caste and profession regarding families
>
> "They shall also ascertain the total number of men and beasts (janghagra) as well as the amount of income and expenditure of each family "

Detailed instructions are given in other places about the standards of weights and measures, measurement of space and time, national accounts, and the duties of Government Superintendent in charge of multifarious departments such as the treasury, mining operations and manufacture, commerce, forest produce, tolls, weaving, agriculture, livestock, armoury, infantry, chariots, etc Specific duties are in fact described for no less than 25 different Superintendents by designation

Ain i Akbari circa 1590 A D

In another peak period of Indian history, in the time of the great Akbar, we find a description of a highly developed statistical system in *Ain i Akbari* which is practically the administration report and statistical returns of his government as it was in 1590 A D In the introduction to the second volume, H S Jarrett observed [3]

> "It will deservedly go down to posterity as a unique compilation of the systems of administration and control through the various departments of Government in a great empire, faithfully and minutely recorded in their smallest detail, with such an array of facts illustrative of its extent, resources, condition, population, industry and wealth as the abundant material supplied from official sources could furnish "

The approach is definitely scientific For example, the author discusses various standards for the measurement of length, and describes how Akbar "seeing that the variety of measures was a source of inconvenience to his subjects, and regarding it as subservient only to the dishonest, abolished them all," and brought the *Ilahi gaz* in general use (Vol II, *Ain* VIII, pp 58 61) In the same way standards are developed for the measurement of land It is noted that "a measure of hempen rope twisted which became shorter or larger according to the dryness or moisture of the atmosphere" (pp 61 62) Therefore, "the *jarib* was made of bamboos joined by iron rings Thus it is subject to no variation, and the relief to the public was felt everywhere while the hand of dishonest greed was shortened " (*Ain* IX, pp 61 62) Other measures of area and volume as well as the standardisation of currency receive minute attention [4]

In *Ain* XI (pp 62 63) a detailed account is given of the classification of land based on the yield of crops A distinction is made between yields in the two seasons spring harvest, and autumn harvest ' Furthermore yields are given for three different grades of soil best middling, and worst, ' and the average of the three grades is calculated as 'the medium product of a *bigha* For the spring harvest figures are given for from 10 to 20 crops, and for the autumn harvest, for 20 or 30 crops [5]

---

[3] English translation by H Blochmann (Vol I, 1873) and H S Jarrett (Vol II, Vol III, 1894) published by the Asiatic Society of Bengal ; Vol II, p vii.

[4] *Ain i Akbari* gives the area revenue valuation strength of army, and other details for about 15 *subahs* (provinces) comprising over 130 *sarkars* (districts) and over 3000 *mahals* (townships and sub divisions) extending from Assam and Arakan to Afganistan the average yield of 31 crops for 3 different classes of land , annual records of rates based on the yield and price of 50 crops in 7 *subahs* (provinces) extending over 19 years (1560 61 to 1578 79 A D) daily wages of men employed in the army and the navy labourers of all kinds workers in stables, etc , average prices of 44 kinds of grains and cereals, 38 vegetables 21 meats and games 8 milk produces oils, and sugars 16 spices 34 pickles 92 fruits 34 perfumes 24 brocades, 39 silk, 30 cotton cloths, 26 woolen stuffs, 77 weapons and accessories, 12 falcons elephants horses, camels, bulls and cows, deer, precious stones 30 building materials , weights of 72 kinds of wood, etc

It is no wonder that speaking of Abul Fazl, Jarrett has remarked (II, p v), that regarded as a statistician, no details from the revenues of a province to the cost of a pine apple, from the organisation of an army and the grades and duties of nobility to the shape of a candlestick and the price of curry-comb, are beyond his microscopic and patient investigation "

[5] One interesting practice deserves notice The ten *ser* tax (*Dahseri*) is thus described "His Majesty takes from each *bigha* of tilled land ten *sers* of grain as a royalty Store houses have been constructed in every district They supply the animals belonging to the State with food, which is never bought in the bazars These stores prove at the same time of great use for the people , for poor cultivators may receive grain for sowing purposes, or people may buy cheap grain at the time of famines They are also used for benevolent purposes, for His Majesty has established in His empire many houses for the poor where indigent poeple may get something to eat " (Vol I, 1927, p 285)

The optional payment of revenue in the form of grain may deserve serious consideration as an alternative method of grain procurement in these days of food rationing in India.

Survey of Eastern India 1807 1815 A D

In the first decade of the 19th century when the British regime in India was rapidly expanding and growing in strength a comprehensive survey of Eastern India was undertaken by Dr Francis Buchanan under orders of the Board of Directors of the Hon ble East India Company dated 7th January 1807 The terms of reference cover an amazingly wide ground as can be seen from the extracts reproduced in Appendix (1) The Survey was pursued by Dr Francis Buchanan for 7 years when only a portion of the territories under the Government of Bengal Presidency was investigated The material was sent to London in 1816 and Montgomery Martin published in 1838 a selection in three volumes comprising over 2400 closely printed pages

The book still makes fascinating reading To whet your curiosity I shall describe some of the items collected about the people of Patna city and the surrounding region Information is given for example about the number and proportion of families in different consumption levels such as families that use milk daily that use milk in the chief season that use milk on holidays that use milk seldom In the same way information is given by categories of families according to the use of different kinds of dress bed sheets blankets the consumption of meat fish milk vegetables spices oil salt rice wheat sweet meats etc different kinds of fuel and oil different types of conveyance state of education etc

The utilization of land is shown by giving the areas separately for a large number of categories such as houses trees kitchen gardens vegetables etc As regards agriculture separate acreage figures are given for the area under 200 different combinations of crops single and mixed A general table is given for the value of the produce in the case of commercial crops and both quantity and value in the case of cereals and food crops together with estimates of the marketable surplus and number of livestock under different categories together with the annual production of milk with prices

There are tables showing the proportion of rent paid by different sections of the population the economic position of farmers with proportion of indebted families and the number of artisans classified into 108 different categories The manufacture of cotton cloth receives special attention and detailed estimates are given of the number of weavers looms monthly production earnings and profit for different kinds of cloth Finally there are tables of exports and imports (for the region surrounding Patna city) in which separate figures are given for 140 different categories of commodities

The report everywhere shows the critical attitude, keen scientific spirit, and the experimental approach of Dr Buchanan The wealth and reliability of the information (as far as this can be judged from internal evidence) make this report one of the most remarkable surveys of all times There is nothing in any subsequent survey in India to approach the one conducted by Buchanan 140 years ago

It is not entirely fortuitous that the three surveys mentioned above were associated with three great periods of political and socio economic expansion in India The statistical system is a visible mark of the political framework of each country The statistical organization therefore inevitably follows the rise and fall of the wider administrative system I shall examine later the position of statistics in the changing conditions of India at the present time

DEVELOPMENTS IN OTHER COUNTRIES

The practice of descriptive statistics gradually developed with ups and downs in all countries of the world Aristotle s work contained references to information about no less than 158 States[*] Besides public administration statistics was in much use in commerce Certain forms of commercial insurance existed in Babylonia Greece and Rome and in the middle ages in Italy By the end of the 18th century life insurance was becoming prevalent in Western Europe All this led to important statistical studies In 1662 for example John Graunt used the register of deaths (Bills of Mortality) in London to investigate population trends Since then in Europe the study of statistics has been closely associated with actuarial science On the break up of the feudal system the expanding national economies required increasing use of factual information for the formulation of financial military and political policies This process has continued down to the present times In fact the need of fighting a total war led to an unprecedented expansion in statistical activities in the last ten years to which I shall again refer

GAMES OF CHANCE AND PROBABILITY

I must now turn to the analytic side of statistics Curiously enough the first phase of development occurred in connexion with games of chance particularly the theory of the equitable division of stakes for which early solutions were given by Cardan and Galileo in the 16th century A little later Pascal and Fermat developed more general methods on the basis of permutations and combinations In this way the concept of probability based on chance gradually became the subject of much mathematical investigations culminating in the work of Laplace in early 19th century

THE TOSSING OF A COIN

The concepts were fundamentally new and deserve consideration A simple example is the tossing of a coin (which is assumed to have no bias in favour of turning up either heads or tails) At each throw it is completely uncertain whether the coin will turn up heads or tails And yet if the coin is thrown a large number of times (or alternatively if a large number of coins is thrown at the same time) it is practically (but never absolutely) certain that heads and tails would turn up approximately in equal numbers The larger the number of throws (or the number of coins thrown at the same time) the greater is the chance of heads and tails being equal in frequency Starting from a situation which is entirely indeterminate and uncertain it is thus possible to reach conclusions with considerable (but never complete) certainty

---

[*] H Westergaard *Contributions to the History of Statistics* 1932 p 4

Several points require to be emphasized First it is quite impossible to predict anything about a single toss of a single coin the prediction (of roughly equal frequency of heads and tails) refers to one whole set of throws That is prediction belongs not to any individual throw but to a group or assemblage of throws as a whole Secondly the existence of fluctuations or variations is inherent in the very nature of the situation The relative frequency (that is the proportion of heads and tails) will never remain exactly equal but will inevitably fluctuate from one throw to another Thirdly because of the existence of fluctuations or variations it is never possible to make any absolutely certain prediction For example however large the number of throws the coin may turn up heads (or tails) all the time In principle even if the coin is tossed a million or a billion (or a larger number of) times in the very long run sometimes the coin should (and must) turn up heads (or tails) on the million or billion (or all) occasions[7] In other words the prediction is essentially a prognosis which is likely to hold only in the long run Fourthly and this is a very important point although the prediction is never absolutely certain it is possible to estimate the limits of uncertainty

The proportion of heads and tails in the tossing of a coin is thus recognized as a statistical variate which is intrinsically subject to variations or fluctuations The proportion of male and female births is exactly analoguous to the proportions of heads and tails in the tossing of a coin Before birth nothing is known about the sex of the individual child and yet the prediction of a roughly equal frequency of the two sexes can be made with practically the same confidence as the equal frequency of heads and tails[8] Any inference about the results or any prediction is therefore necessarily uncertain but the margin of uncertainty is itself capable of estimation

THEORY OF ERRORS OF OBSERVATION

The position is similar in the case of physical observations However careful the observer may be even the simple measurements of the length of a rod have been always found to vary The average of a number of repeated measurements however, usually becomes more and more steady as the number of measurements increases The deviation from the average i e the error of each individual measurement is sometimes positive and sometimes negative and thus behaves like heads and tails in the tossing of a coin In the 18th century the new concepts of probability began to be applied to the adjustment of astronomical observations and physical measurements which led to the growth of the theory of errors culminating in the work of Gauss and Laplace

INDIVIDUAL VARIATIONS AND FLUCTUATION

If the height of a number of individuals is measured these measurements again vary This is equally true for every kind of measurement in biology Fluctuations or variations are thus intrinsic features of all measurements In biology variation itself supplies the material for evolution Variation is also the outstanding feature in all social sciences

MEASUREMENTS AND OBSERVATIONS IN SCIENCE

A crucial point in the argument has been now reached All contingent knowledge is based on measurements and observations Lord Kelvin remarked long ago

> When you can measure what you are speaking about and express it in numbers you know something about it but when you cannot measure it when you cannot express it in numbers your knowledge is of a meagre and unsatisfactory kind[9]

Secondly every set of measurements (in every field of science —physical biological and social) is characterized by variation The aim must therefore be to draw general conclusions from a particular set of measurements taking variation itself into consideration and not ingnoring it

THE CONCEPT OF RANDOM SAMPLES

This is exactly the aim of the theory of estimation and statistical inference Each set of measurements (with its characteristic variation) is recognized to be only one out of many possible similar sets Secondly the totality of all possible sets of measurements (that is the totality of all possible samples) constitute the population or universe in which we are interested In order to reach conclusions about the population or universe it is clearly necessary that a sample should be representative of the universe The condi tion for such representativeness is supplied by the fundamental concept of 'randomness' I do not think it is possible to define randomness but some indication may be given as to its implications Suppose it is desired to find the average height of a particular group of people Obviously it will not do to select individuals who are very tall or very short (or have any other special feature) as the results are likely to get biased The only safe course is to choose the sample without reference to any previous knowledge about the individuals included in the sample A random procedure ensures such selection free from bias Once a random sample is available it is possible to use the calculus of probability in a valid way to reach general conclusions about the statistical population or universe from which the sample was drawn The concept of random samples is thus pivotal in statistical theory

---

[7] This is of course very very unlikely to happen which merely means that the probability is extremely small but in principle not zero

[8] Laplace discussed in a memoir of 1781 the number of male and female births in Paris for 26 years (251 527 males and 241 951 females) from the point of view of probability (*Histoire de l'Academie* for 1778)

[9] It is interesting to note that exactly the same idea occurs in the original meaning of the word *sankhya* (literally number) in Indian thought The phrase *sankhyata* occurs in the *Atharva Veda* in the sense of 'well known For more than three or four thousand years in India an intimate connexion has existed between the concepts of number and adequate knowledge This is why I chose *Sankhyā* as the name of the Indian Journal of Statistics Further references are given in Appendix (2)

UNCERTAIN INFERENCE

Knowledge based on a statistical or random sample is however necessarily incomplete as it relates to only one out of many possible samples Conclusions based on a random sample although valid must therefore be necessarily uncertain It is however the great merit of the calculus of probability that although statistical inference is uncertain it is possible to estimate a valid measure of the degree of uncertainty In practice this is usually secured by stating the chance or odds in favour of any particular inference or result being true (in the sense of the prediction agreeing with subsequent observations) Suppose extensive agricultural trials have been made to compare the yield of two varieties of wheat On available evidence it is then possible to state the conclusion in some such form that the odds are 100 to 1 (or 1000 to 1 or some other odds) that variety A would give a higher yield than variety B The very form of the statement indicates that in the long run 99 times out of 100 variety A would give a higher yield Necessarily therefore once in 100 trials (not in every 100 trials but again in the long run) variety A would give a lower yield This lower yield may however occur in the very first trial The risk is always there Not only this occasionally (or once in 100 trials in the long run) the prediction must prove wrong If it did not then the whole basis on which the prediction was made would itself prove to be wrong In statistical inference we thus reach the fundamental paradox

If statistical theory is right predictions must sometimes come out wrong on the other hand if predictions are always right then the statistical theory must be wrong

DEDUCTIVE LOGIC AND MATHEMATICS

There is a sharp contrast between statistical or uncertain inference and absolutely certain deductive conclusions It is a significant fact that the concept of probability developed very late in the history of human thought as far I know, only during the last two or three hundred years Deductive logic on the other hand, is very old Absolute certainty in fact has long been accepted as the essential characteristic of true knowledge Pure mathematics is the great historic example In pure mathematics the conclusions follow inevitably from the premises and all inferences are absolutely certain This is why Bertrand Russel described pure mathematics as the class of all proposition of the form P implies Q Deductive logic therefore includes the whole of pure mathematics

DETERMINISTIC VIEWS IN PHYSICAL SCIENCES

An invariable sequence of cause and effect is in many ways similar to the formal deductive process in logic and pure mathematics In the physical sciences with the help of the causal principle the rigour of absolute certainty of mathematical reasoning was accepted for a long time as the ideal model Newton in writing his great treatise on the principles of natural philosophy deliberately adopted the mathematical form The possibility of constructing a rational model of the whole universe was a great triumph of the human mind The growing complexity within the natural and later in the biological and social sciences however led to the gradual replacement of the deterministic mathematical model by the probabilistic statistical view This change was brought about not by abstract reasoning but by the force of events within the field of science itself

THE ENTROPY PRINCIPLE

The Newtonian equations of motion become increasingly unmanageable with the increase in the number of particles requiring to be taken into consideration It soon became necessary to study the properties of a system comprising a large number of particles The object now was not to ascertain the motion of each single particle separately but to investigate the collective properties of all the particles taken together Concepts and results already available in the theory of errors of observation were pressed into service to develop the kinetic theory of gases A parallel development of the subject of thermodynamics led to the emergence of the entropy principle The central concept in the second principle of thermodynamics is again randomness so that the principle of the increase of entropy is recognized as nothing but the increasing degree of randomness of the physical universe

THE UNCERTAINTY PRINCIPLE IN PHYSICS

A further shift to a statistical model occurred with the development of statistical mechanics culminating in the enunciation of the uncertainty principle by Heisenberg which denied the possibility of absolutely certain knowledge of both the position and the motion of a particle at any given instant From a theoretical point of view the uncertainty principle would seem to make physical science essentially statistical in nature The belief that complete certitude is an essential condition for genuine knowledge however still persists in certain quarters The uncertainty principle is looked upon as belonging to the region of the very small, and therefore not inconsistent with the deterministic view of the world as a whole

I doubt whether the above view is tenable If science is based on observation and measurement and if each set of measurements is a statistical sample then all scientific conclusions must be of the nature of uncertain inference (with in principle a known margin of uncertainty) The contrast can be clearly seen in the distinction between a mathematical constant and a statistical or physical quantity based on observations The ratio of the circumference to the diameter of a circle is a mathematical abstraction and therefore not subject to any fluctuations All physical quantities on the other hand are based on observation and measurement and are therefore statistical estimates necessarily subject to a margin of uncertainty On this view all scientific predictions must be characterized in principle by a margin of uncertainty

INDUCTIVE LOGIC

It may be observed at this stage that J S Mill s empiricism is a departure from rationalism only in form in as much as the aim of Mill s inductive logic still remains certain inference Similar attempts were made much earlier in India to go beyond the purely formal deductive process Sir Brajendranath Seal has given an interesting account of the doctrine of inference in the *Positive Science of Ancient Hindus* (1915) from which certain extracts have been given in Appendix (3) All these attempts however had certitude as the aim of inference But in Indian thought it was recognized in one sense that this aim is unattainable in practice B N Seal noted for example

> Ultimately we all have to fall back on the rational practice of thinking persons and such persons are always content to act on practical certitude instead of hankering after an unattainable apodectic certainty in the affairs of life This same practical certitude is also the ultimate warrant of the Deductive Inductive Inference by which we ascertain the characters of things without direct perception and through the medium or instrumentality of a mark [10]

FALLIBILITY OF SCIENTIFIC KNOWLEDGE

I have been trying to place before you the view that all scientific knowledge (being based upon evidence which is formally incomplete) is only probable and never absolutely certain All predictions based on scientific knowledge must therefore be fallible and must in fact prove wrong in the long run to the anticipated extent Ernest Nagel observes that those

> who maintain that our knowledge of matters of fact is probable do not thereby maintain that such knowledge is inferior to knowledge of some other kind obtainable by methods different from those the natural sciences employ On the contrary they maintain that probable knowledge is the only kind of knowledge we can find or exhibit, and that the methods and techniques of the sciences are efficacious and dependable precisely because they make available knowledge of that character

Thus in the whole field of science the deductive-mathematical process of absolutely certain inference is being replaced by the probabilistic statistical method of uncertain inference Ernest Nagel has stated the position very clearly

> The long history of science and philosophy is in large measure the history of the progressive emancipation of men s minds from the theory of self evident truths and from the postulate of complete certainty as the mark of scientific knowledge [11]

DETERMINISM AND UNCERTAINTY

If the probabilistic model is accepted as a closer approach to reality then interesting consequences are likely to follow in the field of human thought and philosophy I have no competence to discuss such issues but one or two observations may not be entirely out of place All knowledge based on science and hence all scientific predictions about the future must be recognized in principle as uncertain It is possible however to admit in principle that knowledge about the past may be of a deterministic type The uncertainty about the future may then be interpreted as supplying an opportunity for fresh creation (at least as perceived by the human mind) In fact the present moment on this view is the actual occasion of an ever-continuing stream of creation which is marked in rational thought by the transition from a deductive mathematical to a probabilistic statistical model of reality

STATISTICAL METHODS IN THE CONCRETE

I have so far considered the statistical method in the abstract A brief survey of the scope and range of the statistical method in the concrete is also of interest A convenient way of doing this is to construct a kind of mental map of scientific activities We may start with a geometrical point at the centre to represent pure mathematics On the view which I have expounded pure mathematics (being fundamentally deductive in nature) does not itself belong to the field of science and can be therefore appropriately represented by a mathematical point which has position but no dimension

PHYSICAL SCIENCES

We may draw a small circle round the centre to represent classical physics in which although the form is still mathematical actual knowledge is based on measurements subject to errors of observation Fluctuations are however small in magnitude so that predictions can be made with great certainty (but are still in principle affected by a margin of statistical uncertainty) A second larger circle may be drawn to represent the area of kinetic theory of gases statistical mechanics, and thermodynamics In this region, factors of variation are still amenable to a large degree of control so that the classical method of experimentation (isolating and studying one single factor at a time) is usually available

---

[10] *The Positive Sciences of Ancient Hindus* Longmans, Green & Co., London, 1915, p. 269

[11] *Principles of the Theory of Probability*, University of Chicago, 1939, pp 3-4.

BIOMETRY

A third larger circle may be drawn to demarcate an area where the factors of variation are more complex and less liable to control This broadly represents the field of biological variation In 1900, Karl Pearson coined a new word 'biometry" to indicate generally the methods appropriate to this area The fruitful concept of statistical correlation historically had its origin in this field [12] In the field of biometry, the fluctuations and variations are themselves of great importance, and often supply convenient yardsticks for purposes of measurements

During the last 50 years, biometry has become a very large branch of statistical science It covers practically the whole field of biology and genetics including agriculture and the study of livestock Biometric methods are also being increasingly used in psychology, education, and the medical and social sciences including the study of the human factor in industry

In dealing with living units it is usually impossible to use the classical method of isolating and studying one single factor at a time For example in studying the increase in the yield of crops due to improved seeds or fertilizers or better methods of cultivation, fluctuations in the fertility of the soil from plot to plot, the influence of weather conditions, and many other factors of variation are always present and cannot possibly be isolated A radical departure had become necessary and took place about a quarter of a century ago, in the development of the design of experiments and the analysis of variance under the leadership of R A Fisher[13] He himself has observed

> "No aphorism is more frequently repeated in connexion with field trials than that we must ask Nature few questions, or, ideally, one question at a time The writer is convinced that this view is wholly mistaken Nature, he suggests, will best respond to a logical and carefully thought out questionnaire , indeed if we ask her a single question, she will often refuse to answer until some other topic has been discussed [14]

The central aim of the design of experiments is to make experimental observations in such a way that the different factors of variation would have scope to come into play in a balanced fashion so that it would be possible to study the influence of single factors as well as of various combinations of factors at the same time In fact, R A Fisher has remarked "The more thorough the design of the experiment the more meaningful is the question asked " Actual experience has shown abundantly the great advantages (in economy of time and effort, and in adaptability) of using appropriate statistical designs in scientific and technological experiments of all kinds

The fact of variation is as universal in the field of industrial production as in biology Even with machines of the highest precision, no two units are identical in size or other specifications Usually there is the additional complication of fluctuations in time, but such fluctuations themselves often supply convenient yard sticks for diagnostic purposes So long as the fluctuations remain stable, the system may be considered to be under statistical control W A Showhart[15] used this fundamental concept to develop control limits' and control charts to enable the quality or output of manufactured products being maintained at a desired level These methods found wide applications during the war In fact without the use of such methods war production in the United States and other allied countries could never have been sufficiently stepped up After the war, the use of statistical 'quality control' is steadily increasing all over the world and a beginning has been made in a small way in India also

STATISTICAL SAMPLING

We may add a fourth circle to demarcate the region in which the appropriate tool is statistical sampling Factors of variation are now more complex and are usually not amenable to experimental control This is the field where the traditional method of the exhaustive census or the attempted complete count has been used for a long time R A Fisher has recently described the present position

> "The words sample and sampling, like the word random, have always been central in the development of mathematical, or theoretical statistics With the increased understanding and integration of our science they have now as it were, over flowed from the world of abstractions in which they were generated and refined, and have, in fact, supplied the most adaptable, rapid, economical,

---

[12] In 1877 when Sir Francis Galton measured the size of sweet peas in his studies of heredity, he found a "regression' of the size of the daughter seed, compared to the size of the mother seed, towards the general mean He found the same thing again in connexion with his observations on the height of fathers and sons These studies led to the development of the theory of regression and correlation by Karl Pearson and others It is worth noting that Gauss himself had used the product term in his investigations on the theory of errors, but had failed to reach the concept of correlation. The French astronomer Bravais (1811 63) worked on what is in essence the mathematics of correlation, as early as 1846 The concept of regression and correlation, however, did not emerge until 40 years later; and this also, only under the stimulus of the study of biological variations. This perhaps is a corroboration of the view that statistics is essentially an applied science and not a branch of mathematics

[13] *The Design of Experiments* (Oliver and Boyd, Edinburgh. 1935 4th edition, 1947).

[14] The Arrangement of Field Experiments, *Journal of the Ministry of Agriculture*, Vol 33 (1926), p 511

[15] *The Economic Control of Quality of Manufactured Products* (McMillan & Co , London, 1931), and *Statistical Methods from the View point of Quality Control* (Graduate School, Department of Agriculture, Washington, D C , 1939, reprinted 1945)

and, in the true sense, scientific method of factual ascertainment which we yet possess

> "I have made four claims for the sampling procedure About the first three, adaptability, speed and economy I need say nothing further Too many examples are already available to show how much the new method has to give in these ways But, why do I say that it is more scientific than the only procedure with which it may sometimes be in competition, the complete enumeration ? The answer, in my view, lies in the primary process of designing and planning an enquiry by sampling Rooted as it is in the mathematical theory of the errors of random sampling, the idea of precision is from the first in the forefront The director of the survey plans from the first for a predetermined and known level of precision it is a consideration of which he never loses sight and the precision actually attained, subject to well understood precautions, is manifest from the results of the enquiry" [16]

Rapid developments in this field have taken place during the last ten or twelve years in which India has made significant contributions I shall come back to this subject a little later as it is of great current interest in India

FREE OBSERVATIONS

We may now add a fifth circle to indicate the area in which factors of variation are neither amenable to control, nor to experimentation, not even, in the usual sense of the term, to sample surveys or sample censuses Here the only possible approach is the patient collection of observations followed by classification and painstaking investigation of possible statistical relationships Experimentation is no longer possible, but it is still feasible to compare predictions with subsequent observations Statistical methods are particularly appropriate in this field I shall give one example from my own experience

In 1926 a catastrophic flood occurred in the Brahmani river in Orissa An expert committee of engineers appointed by the Government of India reached the conclusion that the bed of the river had risen by several feet and consequently the flood level was likely to be higher in future The Committee naturally recommended raising the height of the embankments by several feet to give protection against higher floods At the request of the Government of Bihar and Orissa, I made a detailed statistical study, and found a significant correlation between the rainfall in the catchment area and the height of the river flood in the delta [17] Using the statistical relationship, I found that the abnormal rise of the river in 1926 could be reasonably ascribed to exceptionally heavy rainfall in the catchment areas On the basis of such statistical evidence, it was possible to advise Government that there was nothing wrong with the rivers and it was *not* necessary to increase the height of the embankments This advice was given in 1930 The fact that no great change has occurred in the severity or frequency of floods during the last 20 years shows that the statistical findings were correct Direct experimentation in such cases is out of question, the statistical method supplies the only valid tool for scientific investigation [18] Incidentally, in this case, it also saved several crores of rupees

STATISTICS IN EVERYDAY LIFE

The importance of statistics in the field of science is due to its supplying the general method for inductive inference The growing importance of statistics in public estimation, on the other hand, is mainly due to its increasing practical applications in the affairs of everyday life It is necessary to remember that at one time physical science itself was held in low esteem in the public eye, and was often a subject of contempt and ridicule It is interesting to observe that Thomas Sprat made the following observations in 1667, five years after the foundation of the Royal Society of London

> "It is not to be wonder'd at if men have not been very zealous about those studies, which have been so far removed from present benefit, and from the applause of men For what should incite them to bestow their time, and Art, in revealing to mankind, those Mysteries, for which, it may be, they would be only despis d at last ? How few must there needs be, who will be willing, to be impoverish'd for the common good ? While they shall see, all the rewards, which might give life to their Industry, passing by them, and bestow'd on the deserts of easier studies ?[19]

It is only with the great technological achievements of physical science that public opinion changed in a remarkable manner, and it rose in public esteem It is this public esteem which enabled the physical scientists to secure sufficient leisure, support, and recognition to pursue their researches free from care and anxiety This also led to the growth of the belief that scientific research is pure in the degree in which it is removed from practical applications.

---

[16] Presidential address on the Sub Commission on Statistical Sampling' at the Session on Sampling, International Statistical Institute Berne September 1949

[17] One technical point deserves notice The catchment area was divided into two portions, and the rainfall in the two catchments were used as two separate variates for correlation with the height of the river flood *Report on Rainfall and Floods in Orissa Rivers* (submitted in *1930*, and printed by the Government of Bihar and Orissa

[18] I should like to include in the mental map the field of operational research in which the available information is either too meagre, or is not in a suitable form for the calculation of the probability involved in the problem In such cases a decision, however, has to be reached by balancing the risks of gain and loss but without the formal use of the probability calculus. Operational research thus comes within the general scope of the statistical method

[19] *History of the Royal Society*, London, 1667, p. 27.

'PURE' AND 'APPLIED' SCIENCE

I am prepared to admit that a distinction may perhaps be made between 'pure' and 'applied science A subject like physics for example, has a clear responsibility for developing a picture of the universe in terms of physical concepts and elements even if this picture has no practical applications This is also true of other 'pure' sciences like chemistry botany, zoology or geology , each has the task of supplying a world picture in its own terms In an applied science like engineering, the position is quite different It has no responsibility (nor any possibility) of giving a general theory of the world in terms of engineering Its only task is to solve a practical problem It must of course, undertake research in its own field As regards mathematics, it is simply not possible to have too much help from that subject but there is no such thing as 'mathematical engineering'

STATISTICS—ESSENTIALLY AN APPLIED SCIENCE

In the same way, statistics is essentially an applied science Its only justification lies in the help it can give in solving a problem Its aim is to reach a decision, on a probabilistic basis on available evidence If the problem is one of a theoretical nature statistics supplies a valid method for drawing general conclusions from particular experience If the problem is a practical one, statistics supplies the basis for choosing a particular course of action (in preference to other possible courses) by balancing the risks of gain and loss This is why Clark Maxwell once remarked that 'the true logic for the world is the calculus of probability '

On the above view, we can not contemplate any cleavage between the theory and the practice of statistics On one side, statistics must necessarily be tied closely to practical ends On the other, it must try at the same time to make its technical apparatus more and more general, and hence more and more abstracted from particular applications Statistics like engineering requires all the help it can receive from mathematics, but statistical theory can never become a branch of mathematics Individual workers would specialize in particular fields in accordance with their own preference Some would apply their mind closely to practical applications, some to the development of the mathematical technique, and others to the formulation of logical concepts and abstract theory, The number of persons working in the different fields would be naturally determined, partly by the demand for particular types of work (applications, or mathematical technique, or logical concepts and foundations) and partly by the supply of men of the required aptitude and ability The integration of practical applications with mathematical and theoretical studies, which is the characteristic feature of modern statistics, is perhaps a good model for other sciences alss If technology is divorced from scientific researdh, it would soon loose its efficiency and adaptability to meet changing requirements On the other hand, if research is cut off from the stimulus to solve vital problems of human society it would become lost in sterile intellectual acrobatics

THE SOCIAL BACKGROUND OF STATISTICS

In statistical research the greatest stimulus has always come from the need of solving pratical problems R A Fisher's work on the design of experiments was due to the urgent need of solving the dead lock in agricultural field trials W A Shewhart's work on quality control arose from the need of improving the efficiency of inspection in large scale production On the organizational side also statistical work is closely determined by the special needs of the country and by the socio economic frame work Statistics is not only an applied science but is also a public science It is because of the close connexion with public activities that big developments in statistics have always occurred only when there has been need of unified policy and co ordinated action in times of war or peace I shall give three examples

For a long time the volume of statistical work has been greater in the United States than in any other country of the world But it was only during the New Deal in the 1930 s when unified governmental policy became indispensable in the economic field, that effective action was first taken for the central co ordination of the statistical activities of the Federal Government Other large developments took place because of the need of planning in war production, and it was only in 1942 that an Act was passed to assign definite statutory responsibilities to the special Division of Statistical Standards in the executive office of the President of the United States

In the United Kingdom also, under *laissez faire*, statistics had been developing in a more or less haphazard manner without any focal centre within the governmental machinery All this, however, changed rapidly owing to the need of total planning during the war A Central Statistical Organization was set up and was entrusted with the duty of reviewing and making a critical appreciation of all statistical information required by the Cabinet Although the different Ministries have their own statistical divisions, there is complete co ordination at the top After the war, the importance of the Central Statistical Organization has continued to increase with the growth of social and economic planning in the United Kingdom

In the U S S R developments in the statistical field have gone much further From the beginning a Central Statistical Bureau has been an integral part of the GOSPLAN No plan can be put into operation until it is cleared by the Statistical Bureau The Bureau not only helps in preparing the different plans, but also submits reports on the progress of such plans on the basis of the information collected directly by the Bureau In 1947 it had in fact a staff of 22,000 scattered all over Russia and paid and controlled directly by the

Bureau Central control by statistical methods is thus complete in the U S S R[20]

In India also there was a great deal of expansion in statistical work during the war without however any central co ordination Such lack of co ordination was inevitable in the absence of any coherent over all economic policy Until the Government of the country has an urgent sense of the need of statistical services in shaping policy and programme of action little progress is possible In spite of much talk no action was taken for central co ordination in India until very recently There was indifference and even hostility to new ideas and new developments This is typical of the struggle through which scientific innovations must pass in order to establish their worth I may illustrate these points by briefly recapitulating the story of sample surveys in India

SAMPLE SURVEYS IN BENGAL

For a long time crop statistics was known to be unreliable in Bengal In 1934 I discussed with Mr H P V Townend I C S (then Development Commissioner Bengal) the possibility of using random samples for the improvement of the Jute forecast On his initiative a sample survey on an area basis was conducted over the whole province in 1935 I believe this was the first area sample in the whole world[21] The results were not satisfactory chiefly I thought because of defective field work A little later the Indian Central Jute Committee approved a five year scheme for a sampling method for the jute crop Work was started on a very small scale in 1937 and an efficient sampling plan was developed by the Indian Statistical Institute by a series of annual surveys on a gradually expanding scale until the whole province was covered in 1941

Three tests had been laid down for the sampling plan which were adequately fulfilled The method was speedy inexpensive and the margin of uncertainty of the provincial estimate was only about 2 per cent[22] Influential opinion was however still strongly opposed to the scheme and it was terminated at the end of 1941 Since then it has passed through many vicissitudes

The sample survey was revived in 1942 for only one year Since 1939 I had been pressing Government to have the sampling plan extended to rice In view of the cessation of the supply of rice from Burma which by this time had fallen to the Japanese I sent to a high agricultural official in New Delhi in March 1942 a plan for a sample survey of rice in Bengal my letter was not acknowledged In 1943 a famine broke out in Bengal and caused the death of a million and a-quarter or a million and a-half of men women and children The sample survey was started afresh in April 1943 was stopped after two months in June and was again started in August and extended to the rice crop for the first time owing chiefly to the urgent need of food statistics

The adequacy and reliability of the sample survey was challenged on every occasion In fact a sample survey of crops which had been started in Bihar in 1943 44 was discontinued after one year on the advice of the Agriculture Department of the Government of India in spite of a my earnest pleadings in personal discussions and in a letter which I sent to New Delhi on the 23rd March 1945 In Bengal also the position was precarious in 1944 However after many debates and discussions the Government of Bengal decided to continue the sample survey and also to organize a plot to plot enumeration with a view to comparing the two methods

COMPARISON OF SAMPLE SURVEY AND PLOT TO PLOT ENUMERATION IN BENGAL 1944 45

In accordance with the above decision a plot to plot enumeration was conducted directly by the Government of Bengal in the winter (*aman*) rice season of 1944 and the jute season of 1945 while the sample survey was conducted by the Indian Statistical Institute The sample survey was of course much more economical The total cost of the plot to plot enumeration was about Rs 82 lakhs (about £ 61 500 sterling) while the cost of the sample survey was Rs 8 lakhs only or just one tenth The intensity of sampling was unusually heavy owing to the desire of Government to have separate figures for 28 smaller geographical units (districts) For a provincial total, or for 3 or 4 regional breakdowns the cost of the sample survey could have been easily reduced to Rs 6 lakhs or even Rs 4 lakhs From the experience of about 12 years of work in Bengal we have found that a sample survey of crops can supply results of sufficient accuracy for most practical purposes at a cost of only a fifteenth or a twentieth of that of a complete count

It is however in the matter of precision that the sample survey has the greatest advantage It is possible to make a direct comparison for the jute crop of 1945 in Bengal Jute being primarily a cash crop accurate export and trade figures become available about 15 months after the harvesting season The sample-survey estimate submitted to Government in September 1945 was 7 540 bales of jute,[23]

---

[20] It is interesting to note that about a year ago the Central Statistical Bureau was removed from the GOSPLAN and was placed directly under the Council of Ministers (which corresponds to the Cabinet in India) This would seem to indicate that the Bureau now has the further responsibility of submitting reports on GOSPLAN itself

[21] As far as I know Sir John Hubback was the first person to consider random sampling for estimating crop areas but he did not use it in practice His own work was concentrated on statistical sampling for the yield of rice in Bihar and Orissa in the early 1920's His original report Sampling for Rice Yield in Bihar and Orissa published in 1927 as Bulletin No 166 by the Agricultural Research Institute Pusa was reprinted it *Sankhya* the Indian Journal of Statistics Vol 7 Pt 3

[22] A full accout of the work up to 1941 was given in the paper On large Scale Sample Surveys *Phil Trans Royal Society of London* Vol B 231 (1944) 329-451 some later work has been described in Recent Experiments in Statistical Sampling in the Indian Statistical Institute *Jour Royal Statistical Society* CIX (4) 1946 325 378

[23] 1 bale=400 lbs of jute

The official forecast in the same month based on the plot-to-plot enumeration was 6 304 bales According to the customs and trade figures which became available in January 1947 the Bengal production was 7 562 bales The plot-to-plot enumeration gave an under estimation of 16 6 per cent while the sample survey figure differed by only 0 3 per cent from the estimate based on trade figures Details of the comparison are given in Appendix (4) *The plot to plot enumeration was ten times more expensive and yet gave entirely inaccurate results*

The reason for the greater reliability of the sample survey is clear The total staff employed in the plot to-plot enumeration was about 33 000 against roughly about 600 or 700 in the sample survey Sample surveys require a much smaller staff It is therefore always possible to employ better trained people on higher pay and also to maintain close super vision on their work In consequence the primary material in sample surveys is usually of much better quality and furnish final estimates of greater accuracy

In Bengal the superiority of the sample survey was finally acknowledged in January 1948 when the sample estimates were ordered by the Government of the Province to be accepted in future as official crop estmates It had taken eleven years (since 1937) to achieve this result

A good deal of similar evidence has accumulated in other countries of the world I shall refer to some very recent work in Japan At the request of the Occupation Authority the Japanese Government conducted in 1948 a plot to plot enumeration of crops (on the basis of old cadastral survey records) of the whole country Sample surveys were superposed to assess the accuracy of the plot to plot enumeration The sampling work was done with great care in fact with plane table operations with the help of surveying instruments The combined under-estimation (due to both non reporting of fields and under statement of crop area reported) was about 9 5 per cent for paddy rice 20 per cent for mixed cereals more than 26 per cent for sweet potatoes and fully 35 per cent for upland rice [24]

RECENT CHANGES IN ATTITUDE

In recent years the sampling method has won increasing recognition all over the world In 1947 the United Nations established a Sub Commission on Statistical Sampling which has already met three times in 1947 1948 and 1949 and has issued three reports covering a very wide field In India also there has been a distinct change of attitude The Government of India are seriously considering the possibility of using sampling methods in the field of agricultural statistics This has been brought about partly no doubt by the increasing prestige of the method outside India But it is also symptomatic of a deeper change The Government of India are giving increasing attention to the all round improvement of the statistical services of the country This in its turn is due to a growing awareness of the urgent need of unified economic policy and action on the part of Government It is the urge of solving vital national problems which is giving real strength to the progress of statistics in India I shall now turn to some of these problems

THE FOOD CRISIS IN INDIA

The biggest single problem in India at present is the shortage of food supply On the 28th November 1949 Jawaharlal Nehru the Prime Minister of India is reported to have declared I desire to make it perfectly clear that whatever happens whether there is a cyclone or an earthquake we are determined to stick to the target date of 1951 after which we shall not import food grains for our consumption He stated that this decision had been forced on the country by the pressure of events for no country could continue to live beyond its means which of course meant its production in its fields or its factories

I shall try to give a statistical commentary on the Prime Minister s statement This will serve two purposes It will show how statistics comes into the picture and how statistics can help in solving the problem It will also show how inadequate is the available statistical information and how much it requires to be improved The figures quoted by me are therefore necessarily illustrative

INCREASING PRESSURE OF POPULATION

The food position can be judged only in relation to population and other resources of the country We know the total geographical area of the Indian Union It is about 1 22 million sq miles or 780 million acres [25] As regards the population the last decennial census was taken in February 1941 Since then conditions have been abnormal owing to war the famine in Bengal in 1943 and the partition in August 1947 with subsequent large shifts of population On the available information the total population at present would seem to be something between 34 and 35 crores (340 and 350 millions)

The density of population is thus very high something like 290 per square mile which is bigger than the density in most countries of the world with the exception of the highly industrialized countries in Western Europe and Japan If we consider the individual share in India we have only about 2 25 acres per head [26] In comparison China presumably has about 6 acres the United States about 13 acres and the U S S R nearly 28 acres for each individual

---

[24] United Nations document E/CN 3/Sub 1/17 Appendix C pp 27 32 and also an article on the Incompleteness in a Census of Crop Areas in Japan by Charles F Sarle in *Agricultural Economics Research*, April 1949 (published by the United States Department of Agriculture)

[25] 3 159 million sq kilometers

[26] The toal area under cultivation in India is not known accurately It is probably something like 35 or 40 per cent of the whole area. The share of cultivated land is thus well below one acre per head

The pressure on land is many times greater in India compared to other countries with a large population

The population is also increasing at a rapid rate Between 1931 and 1941 the rate of increase was about 1 4 per cent for the Indian Union [27] If this rate is being maintain d the population of India is increasing at present by nearly five millions every year This is more than the total population in each of about 24 or 25 member States of the United Nations Owing to the adverse conditions created by the war and the partition of India the rate of growth may have slowed down If it is only 1 per cent the increase is still some thing like 3 5 millions per year [28]

INADEQUACY OF FOOD STATISTICS

About population we have some information The position is much worse about food statistics In one province West Bengal (covering only about 2 5 per cent of the total area of India) statistical sampling is being used and can be depended upon to supply estimates of the production of rice with a margin of uncertainty of about 2 per cent For roughly half the total area of India reports are available from *patwaries* (village revenue staff) or *chowkidars* (village watchmen) but nothing is known about their accuracy as no objective checks have been made In roughly one fifth of the whole area reports are received from the State authorities but nothing is known about the primary agency No reports whatsoever are available about the food production for the remaining 30 per cent of Indian Union and a conventional figure is written down every year in New Delhi In spite of the Grow More Food campaign conducted for several years according to official estimates of the Ministry of Agriculture apparently no appreciable increase has occurred in the production of food It is best to confess that we do not know the real position

CRITICAL BALANCE BETWEEN FOOD AND POPULATION

There is some indirect evidence Actuarial estimates on the basis of the decennial censuses between 1881 and 1931[29] show that there has not been any appreciable increase in the expectation of life at birth which hovered round or below 25 years during this period This suggests that although population increased at a rapid rate there was no over all improvement of the vitality of the people

The famine in Bengal in 1943 was also an ominous indication From the information collected by the Inbian statistical Institute in the course of a sample survey of famine conditions I believe the total number of deaths was something between one-and a-quarter and one and a-half million The total loss (killed and missing) in the second world war was about 330 000 for the U S A and 300 000 for the United Kingdom [30] Thus the famine casualty in Bengal was double or more than double of the total war casualty for the U S A and the U K. taken together It may be noted that in 1943 the area of the undivided province of Bengal was about 78 000 sq miles and the estimated population about 63 millions The density was thus of the order of 800 per sq mile which was higher than that in even the most highly industrialized countries of the world The terrible pressure of population was no doubt a predisposing factor in the famine [31]

INCREASING FOOD IMPORTS

Some further indirect information is available from export and import statistics Before the separation in 1937 Burma provided an abundant supply of rice During the first two or three years of the war the net import was negligible as the following figures will show

NET IMPORT OF CEREALS PER PERSON

financial year	exrapolated population in millions	net import of cereals in million tons	import in lbs per year per person
(1)	(2)	(3)	(4)
1941–42	390 3	0 43	+ 2 5
1942–43	395 4	–0 29	– 1 6
1943–44	400 4	0 33	+ 1 8
1944–45	405 5	0 73	+ 4 0
1945–46	410 6	0 93	5 1
1946 47	415 7	2 41	+12 9
1947–48	335 2	2 18	14 6
1948 49	337 9	2 78	+18 4

(1) Population figures for undivided India were calculated by linear extrapolation with the observed growth rate between 1931 and 1941 Figures after partition are based on the *Census of India Paper No* 2

(2) Up to 1942 43 net imports in col (3) are taken from the *Food Statistics of India* (1946) published by the Food Department from 1943 44 the figures are taken from *Indian Food Statistics* (August 1949) published by the Ministry of Agriculture Since 1943 44 the figure relate to rice wheat maize millet barley and wheat flour with a few minor variations.

In 1943 44 the year of the Bengal famine and the first year of introduction of food rationing the net import was quite small and only about 1 8 lbs per head per year During the last five or six years the position has grown steadily worse The net import rose to about 18 lbs per head in 1948 49 and the expenditure incurred was something like Rs. 120 or 130 crores (about £ 100 million sterling) The signi finance of this figure can be appreciated when it is recalled that the total revenue budget of the Government of India in 1949 50 is of the order of Rs 320 crores (£ 240 million sterling)

---

[27] *Census of India Paper No 2* p 6 (Government of India) The rate of growth during the same period in undivided India was 1 5 per cent year

[28] During the 40 years between 1901 1941 the average rate of increase was about 1 per cent per year in undivided India and over 0 8 per cent per year in the Indian Union Even at this lower rate the increase would be about 3 millions per year

[29] No information is available for the 1941 census as age tables were not prepared These are however now being now being constructed inhe Indian Statistical Institute on the basis of the 2 per cent Y sample

[30] *Encyclopaedia Britannica Book of the year* 1946 p 846

[31] A Sample-Survey of After Effects of the Bengal Famine of 1943 *Sankhya The Indian Journal of Statistics* Vol 7 (4) 1946 337-400

Another aspect of the problem is even more serious If the food production and the home consumption remain constant then the surplus coming to the market would also remain constant In this situation the total import should increase in proportion to the growth of population In actual fact the import rose from 0 33 million tons in 1943 44 to 2 78 million tons in 1948 49 an increase of more than eight times in five years This definitely shows that the supply coming into the market (through procurement or otherwise) has been steadily decreasing This is the most alarming feature of the present situation

STATISTICAL BASIS OF A RATIONAL FOOD POLICY

What is the solution? There is obviously no single remedy The problem has to be attacked on many fronts and statistics can help on all fronts I shall briefly try to indicate the magnitude of the task First every effort must be made to increase the crop production Fertilisers improved seeds irrigation and better methods of cultivation are already being used and must be pushed much further Experimentation at the research level in agricultural field trials must be continued and developed with closer gearing to actual conditions of cultivation Another possibility is the improvement of varieties through fundamental research in genetics The spectacular increase in the yield of maize in the U S A is a striking example of the success of such researches Rice offers a promising field for similar work and an increase of 25 per cent or 30 per cent in the yield is a definite possibility Well equipped centres for the study of rice genetics should be obviously established without delay Here statistics can render effective help In fact in the field of agricultural experimentation and genetics powerful methods like the designs of experiments the analysis of variance and the theory of estimation are already available

INCREASING DIFFICULTIES IN THE FUTURE

It is certainly necessary to attain self sufficiency in food in 1951 But this is not enough The production of food must keep pace with the growth of population But not only food it is also necessary to produce new houses clothes and thousands of other things in increasing quantities Production must keep pace with population The future trend of population in India is therefore a matter for serious concern Available evidence indicates that at the existing level of production the balance has already become adverse A further and continual growth of population without a commensurate growth in the means of production will be disastrous The only way is to develop our national resources.

INDUSTRIAL DEVELOPMENT

Rapid industrial development is one possibility Government have already started work on a number of big multi purpose dams for both irrigation and power A beginning has also been made with machine tools and other basic industries and heavy chemicals The building of houses electricals and other innumerable industries (including production of consumer goods) must be stepped up All this would require capital goods in the way of plant and equipment land and buildings and labour

It will be useful to obtain even a very rough idea of the capital requirement The ratio of the gross value of the annual product to the capital investment varies widely from one industry to another The ratio would be small in the case of iron and steel or basic industries the gross value of the annual product may be something like one third or one fourth or even one fifth of the invested capital In electricals and lighter industries the ratio may be unity or even higher Unfortunately very little information is available [32] At a rough guess the over all value of the ratio is likely to be something between half and unity

It is also necessary to take into consideration what the economists call the multiplier effect To put it crudely the multiplier stands for the additional value of products and business and other activities stimulated by the increase in the primary product (For example an increase in the production of steel and cement may be expected to lead to an increase in the building of houses and construction work and other industries in an indirect way) No information is available about the value of the multiplier in India It is sometimes guessed that the multiplier may be something like 1 5 or so To get a dimensional figure we may perhaps assume that an investment of say one crore of rupees would lead to an increase of an equal amount in the national product (inclusive of the multiplier effect) The actual ratio may be somewhat higher or somewhat lower but this would give a rough dimensional picture [33]

Consider the implications To increase the value of the national product by one rupee per head per month or say twelve rupees per head per year it is necessary to invest about 420 crores of rupees (=Rs 12 × 35 crores) or £ 310 million sterling Compare this figure with the budget of the Government of India which is something like Rs 320 crores (£ 240 million sterling) in 1949 50 Even if this whole amount is used for industrial development the value of the national product is not likely to increase by more than say twelve annas or a rupee per head per month It is clear that the Government of India alone can do very little The industrial development of India depends entirely on the efforts which the people of the country are prepared to make

---

[32] It may be noted that the over all ratio of the annual value of the product of the invested capital is about 1 6 in the case of the industries covered by the Industrial Census of 1946 (Ministry of Industry and Supply) It must be remembered however that most of the capital investment took place long ago while the annual product was valued at 1946 prices If the value of the plant machinery and building is re calculated at 1946 or current prices the total amount of capital investment would be much higher than that actual shown in the returns That is the ratio would certainly fall much below 1 6

[33] It is assumed of course that the new capital investment is not in competition with existing investments that is, does not divert any of the factors of production from existing modes of production

THE NATIONAL INCOME

The next question which arises is the extent to which the people can afford to contribute to industrial development Investing one rupee would bring a return of one rupee in future years but whether one can afford to invest even one rupee depends on his income This brings us to the question of the national income of India Little reliable information is available[34] Again one can only guess Perhaps the monthly income is Rs 12 or may be Rs 15/ per head We do not know but this may be the right order We have also the other guess of a rupee for a rupee that is a future national product of one rupee for a present investment of one rupee The choice is definitely between jam to day and jam tomorrow We cannot have both Indeed unless we save and invest for the future we may have less and less in future

THE STATISTICAL POSITION

With meagre material I have constructed a dimensional picture which is admittedly very rough It will have served its purpose if it has conveyed to you some idea about the magnitude of the task in front of us Secondly if it has made you feel the urgent need of having more and better statistics Along with the efforts to increase food production attempts must be made to improve the statistics not only of the production of food but of its consumption and distribution A gap of 10 years between population censuses is no longer tolerable It is necessary that we should have information about the growth of population every year We require information about the distribution of income and expenditure in different sectors of national economy and in different strata of the population We must in fact set about earnestly to develop a comprehensive system of social accounting for the whole nation

Of capital requirements I have given a sombre picture In one sense it is however not as dark as it looks at first sight The capital investment is broadly of three kinds First machinery and equipment (and technical personnel) which we must import from abroad and must pay for ultimately in hard cash Secondly land and water minerals forests livestock and animals which we have in the country and also buildings and material equipment which we have or which we can produce in India And finally, man power and labour which we have in abundance In the beginning the share of imported equipment from abroad must be necessarily heavy but as the basic industries develop this item should become smaller and smaller The other two items man power and material resources are our own The imputed value entering into the capital account is in a real sense a matter of book keeping We can make what we like of these items If the people and the Government are united in one common endeavour then the human labour and the material resources in the country are completely at our disposal for national development

If the statistical picture I have placed before you is not hopelessly wrong then we are in difficult times and are probably facing greater difficulties than we have ever done in the past The united effort of the Government with the people can save us Such united effort can be brought about only by concerted action To prevent waste of money effort resources and most critical of all to prevent any further waste of time planning on a national scale is essential

NATIONAL PLANNING

National planning has several aspects First there is the preparation of plans at the technical level requiring the help and cooperation of workers in every branch of science and technology Statistics is indispensible at this stage for the supply of basic information Secondly the individual plans have to be built into a general plan Here statistics is the common denominator and supplies the common binding medium for the whole Thirdly the plan has to be implemented At this stage also statistics can help in two ways Firstly by establishing scientific controls to ensure that the programme of action proceeds on efficient lines Secondly by conducting continuous assessments of the results by keeping account of the input of money effort and resources and measuring what is obtained in return The process is never ending In the actual working of the plan defects are revealed and new possibilities emerge requiring consequential changes Statistics is again invaluable in diagnosing weaknesses in guiding controlled experiments and in suggesting improvements *Statistics is thus pivotal in the dynamics of national planning* I hope you have now received a proper answer to the question Why statistics?

RECENT DEVELOPMENTS IN INDIA

As I have already indicated, the progress of statistics must depend upon and is closely determined by socio-economic trends In India we have seen during the last one year hopeful signs of advance A Standing Committee of Departmental Statistics with representatives from the different Ministries of the Government of India was established in October 1948 A Central Statistical Unit was created, under the charge of a Statistical Adviser to the Cabinet, on the 28th January 1949 For the first time, a permanent office for the Census and Vital Statistics was established under a Registrar General and ex-officio Census Commissioner in May 1949 A first comprehensive report on the industrial census of 1946 was published in July 1949 A National Income Committee was set up in August to review the position in this field and to make such estimates as may be possible And the Central Statistical Unit was converted into a Central Statistical Organization on the 21st December 1949 All this indicates a move towards a more comprehensive review and formulation of the economic policy of the country We may look forward to reach again, of course, in a more modern form, the state of development in statistics which was reached in India in the days of the survey of Eastern India in early 19th century, or in the days of Akbar at the close of the 16th century, or in the days of Asoka in the third century B C

---

[34] Pioneer work was done by Dr V K R V Rao who gave in 1940 an estimate of the national income for 1931 32 and in 1944 gave a tentative estimate for 1942 43 No authoritative estimates for recent years are yet available

THE CHOICE BEFORE US

Our vast population is a great asset, but only in a potential form In India we have every year a vast quantity of water in the form of rainfall Most of it is wasted Sometimes in times of flood, it becomes a menace But by building dams and hydrels we can put it to work, and make it a source of power for fruitful production In the same way, our vast man power is at present lying mostly stagnant A great deal remains idle, and a great deal is wasted in inefficient production Perhaps it is wise to remember that out of control it may also become a menace fraught with grave dangers of self destruction But, if we can harness this living reservoir of power there is nothing which we cannot accomplish

So far attempts have been made to hire this power in a market place We should think seriously whether we have the means, or the time, to continue to do so Conditions are changing rapidly It is a matter for serious thought whether or not the wiser policy would be to rally the common man into a great effort for national welfare We look to our political leaders for guidance, decision, and action

In a national plan, scientists and technologists also have to make their contributions They can give the labour of their thought, and by the skill of their research and experimentation, show how to overcome difficulties and open out new possibilities The statisticians have a humble role, but they also can help in reaching vital decisions To this great ask I call all my friends and colleagues

---

APPENDIX 1

SURVEY OF EASTERN INDIA 1807-1815

[The following extracts are taken from the Introduction to "The History, Antiquities, Topography, and Statistics of Eastern India" by Montgomery Matin, London, 1838]

The Survey of the districts of Behar and Patna, of Shahabad, Bhagulpoor, Dinajpoor, Goruckpoor, Purniya, Rungpoor, and Assam, forming the Eastern territories of British India, and containing upwards of 60,000 square miles and nearly 15,000,000 of British subjects, was executed by the Supreme Government of Bengal, under orders from the Court of Directors of the Honourable East India Company, dated the 7th of January, 1807, wherein the Honourable Court observe, "We are of opinion that a statistical survey of the country, under the immediate authority of your Presidency, would be attended with much utility, we therefore recommend proper steps to be taken for carrying the same into execution"

The extent of the investigation will be seen from the directions ssued for the guidance of the survey by the Supreme Government under date 11th Sept which were as follows —

> Your inquiries are to extend throughout the whole of the territories subject to the immediate authority of the Presidency of Fort William
>
> The Governor General in Council is of opinion that these inquiries should commence in the district of Rangpur, and that from thence you should proceed to the westward through each district on the north side of the Ganges, until you reach the western boundary of the Honourable Company s provinces You will then proceed towards the south and east, until you have examined all the districts on the south side of the great river, and afterwards proceed to Dacca and the other districts towards the eastern frontier
>
> Your inquiries should be particularly directed to the following subjects, which you are to examine with as much accuracy as local circumstances will admit
>
> I A Topographical account of district, including the extent soil plains, mountains, rivers harbours towns, and sub divisions together with an account of the air and weather, and whatever you may discover worthy of remark concerning the history and antiquities of the country
>
> II The Condition of the Inhabitants, their number, the state of their food clothing and habitations, the peculiar diseases to which they are liable, together with the means that have been taken or may be proposed to remove them the education of youth and the provision or resources for the indigent
>
> III Religion the number, progress and most remarkable customs of each different sect or tribe of which the population consists, together with the emoluments and power which their priests and chiefs enjoy, and what circumstances exist or may probably arise that might attach them to Government, or render them disaffected
>
> 'IV The Natural Productions of the Country, animal, vegetable, and mineral, especially such as are made use of in diet, in medicine, in commerce, or in arts and manufactures. The following works deserve your particular attention:
>
> '1st The fisheries, their extent, the manner in which they are conducted, and the obstacles that appear to exist against their improvement and extension
>
> '2nd The forests, of which you wil' endeavour to ascertain the extent and situat on, with respect to water conveyance. You will investigate the kinds of trees which they contain, together with their comparative value and you will, point

out such means, as occur to you, for increasing the number of the more valuable kinds, or for introducing new ones that may be still more useful

"3rd The mine and quarries are objects of particular concern You will investigate their produce, the manner of working them, and the state of the people employed.

V Agriculture under which head your inquiries are to be directed to the following points,

'1st The different kinds of vegatables cultivated, whether for food forage medicine, or intoxication, or as raw materials for the arts the modes of cultivation adopted for each kind, the seasons when they are sown and reaped the value of the produce of a given extent of land cultivated with each kind. The profit arising to the cultivator from each, and the manner in which each is prepared and fitted for market Should it appear that any new object of cultivation could be introduced with advantage you will suggest the means by which its introduction may be encouraged

"2nd The implements of husbandry employed with the defects and advantages of each and suggestions for the introduction of new ones that may be more effectual

'3rd The manure employed for the soil, especially the means used for irrigation

'4th The means used for excluding floods and inundations, with such remarks as may occur to you on the defects in their management

5th The different breeds of the cattle, poultry and other domestic animals reared by the natives The manner in which they are bred and kept the profits derived from rearing and maintaining them, the kinds used in labour, whether the produce of the country be sufficient, without importation, to answer the demand, or to enable the farmer to export and whether any kinds not now reared might be advantageously introduced

6th Fences the various kinds that are used and that might be introduced with observations concerning the utility of this part of agriculture in the present state of the country

'7th The state of farms, their usual size the stock required, with the manner in which it is procured, the expense of management the rent, whether paid in specie or in kind; the wages and condition of farming servants and labourers employed in husbandry, tenures by which farms are held, with their comparative advantages, and the means which, in your opinion, may be employed to extend and improve the cultivations of the country

'8th The state of the landed property and of the tenures by which it is held in so far as these seem to affect agriculture

'VI The progress made by the natives in the fine arts in the common arts and the state of the manufactures, you will describe their architecture sculpture and paintings and inquire into the different processes and machinery used by their workmen and procure an accunt of the various kinds and amount of goods manufactured in each district It should also be an object of your attention to ascertain the ability of the country to produce the raw materials used in them ,and what proportion, if any is necessary to be imported from other countries and under that advantages or disadvantages such importation now is, or might be made, you will also ascertain how the necessary capital is procured, the situation of the artists and manufactures, the mode of providing their goods the usualrates of their labour; any particular advantages they may enjoy, their comparative affluence with respect to the cultivators of the land, their domestic usages the nature of their sales and the regulations respecting their markets Should it appear to you that any new art or manufacture might be introduced with advantage into any district, you are to point out in what manner you think it may be accomplished.

'VII. Commerce the quantity of goods exported and imported in each district, the manner of the conducting sales, especially at fairs and markets; the regulation of money, weights, and measures, the nature of the coveyance of goods by land and water and the means by which this may be facilitated, especially by making or reparing roads

"In addition to the foregoing objects of inquiry, you will take opportunity of forwarding to the Company's Botanical Garden at this presidency, whatever useful or rare and curious plant and seeds you may be enabled to acquire in the progress of your researches with such observations as may be necessary for their culture"

APPENDIX 2

THE IDEA OF DETERMINATE KNOWLEDGE IN ANCIENT INDIA

[The following is reproduced from the Editorial, *Sankhyā*, Vol 1, Part 1 (June 1933), pp 3 4]

We are convinced that statistics represents a fundamental method of analysis of data in the mass which is applicable to any science of observation, and we feel that it is desirable to emphasize this essential unity in the methodology of statistics

We believe that the idea underlying this integral concept of statistics finds adequate expression in the ancient Indian word *Sankhyā* In Sanskrit the usual meaning is 'number', but the original root meaning was 'determinate knowledge'[1] In the Atharva Veda a derivative form *Sankhyātā* occurs both in the sense of 'well known' as well as 'numbered'[2] The Lexicons give both meanings Amara kosa gives *sankhyā* = *vicāranā* (deliberation, analysis) as well as 'number,' also *sankhyāvān* = *panditah* (wise, learned)[3]

---

[1] The word can be written *sumkhya* or in a simpler form as *sankhya*, the sound of *anusvara* (nasal glide following a vowel) assimilating with the following sound of *k* and becoming a velar nasal (like *ng* in English *sing*) The simpler spelling also indicates the current pronunciation (like *sungkhi ah*)

The word is derived from *khyā* (to perceive view', 'to be known,' 'to make well known' in Monier Williams's Dictionary) The root meaning is 'determinate knowledge', 'deliberation' or 'whatover helps us in obtaining determinate knowledge' according as the *krt* suffix is taken in the active or instrumental form From the latter phase is derived the technical meaning of 'number'.

[2] Atharva Veda, 4 25 2 It also occurs in 4 16 5 and 12 3 28.

Winterintz after a full discussion of the date of the Vedic age says "we shall probably have to date the beginning of this development about 2000 or 2500 B C, and the end of it between 750 and 500 B C" *History of Sanskrit Literature* (English Translation, Calcutta University 1927), Vol I, p 310 While the present form of the Atharva Veda is believed to be later than that of the Rg Veda, much of its material is considered to be as old as, if not older than, many portions of the Rg Veda (Winternitz, p 127) The word *sankhyā* is in common use in the sense of number in the time of *Pānini*

[3] Amara-koṣa, 1 4 2 (*dhivarga*) '*carcā sankhyā vichāranā*' (deliberation, reasoning, investigation) Also 2 7 5 (*Brahma varga*) "*sankhyāvān panḍitah*"

Monier Williams gives 'number, numeration; deliberation, reasoning, reflection; reason, intellect, understanding' under *sankhyā*.

The same dual sense is attached to its derivative from *Sānkhya*[4] which is the name of the most famous analytic philosophy of ancient India The name of the philosophical system is explained in both ways as a philosophy based essentially on enumeration of the categories beginning with Nature or Root Cause Or else a philosophy by which is revealed the adequate knowledge of reality[5] The root meaning is also met with in the Mahabharata in the Gita[6] portion where the *Sānkhya* system of philosophy is classified with the Vedanta as being based on *jnana* (or intellectual cognition) as distinguished from the Yoga systems Sridhara in his commentary on the Gitā explains *Sānkhya* as *samyag jnana* that is proper cognition or 'adequate knowledge

The history of the word *sankhyā* shows the intimate connexion which has existed for more than 3000 years in the Indian mind between adequate knowledge and number As we interpret it the fundamental aim of statistics is to give determinate and adequate knowledge of reality with the help of numbers and numerical analysis The ancient Indian word *Sankhyā* embodies the same ideas and this is why we have chosen this name for the Indian Journal of Statistics

APPENDIX 3

THE DOCTRINE OF INFERENCE IN INDIA

[*The following extracts are taken from* Brajendra nath Seal s *The Positive Sciences of the Ancient Hindus* 1915]

The Doctrine of Inference Anumāna (Inference) is the process of ascertaining not by perception or direct observation but through the instrumentality or medium or a mark that a thing possesses a certain character Inference is therefore based on the establishment of an invariable concomitance (*Vyapti*) between the mark and the character inferred The Hindu Inference (Anumāna) is therefore neither merely formal nor merely material but a combined Formal Material Deductive inductive process It is neither the Aristotelian Syllogism (Formal Deductive process) nor Mill s Induction (Material Inductive process) But the real inference which must combine formal validity with material truth inductive generalization with deductive particularisation (pp 250 251)

The later Buddhists formulated the canon of a modified Method termed the Panchakarani a Joint Method of Difference which combines the positive and the negative Methods of Difference (The Method of Addition and the Method of Subtraction) in a series of five steps and which equally emphasises the unconditionality and the immediateness of the antecedents as essential moments of the causal relation This is neither agreement in presence nor agreement in presence as well as absence (the foundation of J S Mill s Joint Method of Agreement) but the Joint Method of Difference The Panchakarani runs thus —

The following changes being observed every thing else remaining constant the relation of cause and effect is rigorously established —

First step–	The cause and the effect phenomena are both unperceived
Second step—	Then the cause phenomenon is perceived
Third step–	Then in immediate succession, the effect phenomenon is perceived
Fourth step	Then the cause phenomenon is sublated or disappears
Fifth step—	Then in immediate succession the effect phenomenon disappears (pp 258–259)

APPENDIX 4

COMPARISON OF ESTIMATES OF JUTE ACREAGE IN BENGAL 1945

	ITEM	1944 45	1945 46
		(thousand bales)	
(1)	Consumption during the season		
	(1 1) in jute mills (actual)	6 00	6 308
	(1 2) exports (actual)	1 050	2 213
	(1 3) in villages (estimated)	600	600
	total	7 650	9 121
(2)	Subtract quantity consumed from previous years stock	324	—697
(3)	Subtract jute crop in other provinces	—598	—862
(4)	Balance Bengal crop from trade figures	6 728	7 652
(5)	Bengal official forecast (complete count)	4 895	6 304
(6)	Bengal crop sample survey	6 480	7 540
(7)	Discrepancy of official forecast on (4)	—27 2%	16 6%
(8)	Discrepancy of sample survey on (4)	3 6%	0 3%

Source Figures used in this table were taken from the *Final Review of the Jute Crop* (published by the Government of Bengal) and the *Monthly Summary of Jute and Gunny Statistics* August 1946 and 1947 (issued by the Indian Jute Mills Association)

NOTES ON CALCULATION (Paragraph numbers refer to serial numbers of items in the above table)

(1 1) *Consumption in Jute Mills* The Indian Central Jute Committee (ICJC) which is a statutory organization established by the Government of India collects and publishes these figures every year The Indian Jute Mills Association (IJMA) collects the figures from the member mills and supply a consolidated statement to the ICJC Mills outside the Association send their figures direct to ICJC These figures are consolidated in the office of the ICJC and two figures are published one for the Association Mills and the other for the other Mills The total is published in

---

[4] It is interesting to observe that the *Sankhya* teaches differentiation between spirit ((*purusa*) and matter (*prakrti*) plurality of souls independent eternity of matter and explains creation as an evolutionary unfolding of the world from original matter (Winternitz p 494)

[5] In Vacaspatya we have *mūla prakrtyadi pad irthana n gananā* (the enumeration of the categories beginning with Nature the Root Cause) Monier Williams gives relating to number or calculation enumeration deliberating reasoning rational discriminative under *sānkhya*

In the commentaries *Sankhya* is usually derived as *samyak khyayate vastutatvam anaya* (by which is reavealed fully the essence or truth of reality)

Fitz Edward Hall (*Sankhya Sara* Bibliotheca Indica and quotes on p 3 Dr Rōer in support 'The term *Sankhya* has two meanings enumeration and investigation (*Lecture on the Sankhya Philosophy* p 8)

The dual significance of the word *sānkhya* is the subject of a pun in the opening couplet of Bhāskarācārva s *Bija ganita* the well known treatise on Algebra

[6] Bhagavad Gitā 2 39. It is usually placed in the early centuries A D (Winternitz, p 438)

both the publications mentioned above but as the *Final Review* was not published after 1946 the revised figures published by the IJMA were used in the present table

(1 2) *Exports* As exports of raw jute have to pay a duty depending on the weight of jute exported a very accurate account of the quantity of jute exported is kept by the Customs authorities A daily list of exports showing quantities exported is published by the Customs authorities and the consolidated annual figure is published in the *Seaborne Trade of India* by the Government of India

(1 3) *Consumption in villages* Several years ago this figure was fixed at 5 lakhs of bales by the IJMA In 1941 a survey was conducted by the ICJC in collaboration with the Indian Statistical Institute to estimate the consumption in villages by a sample enquiry and the figure was changed to 6 00 000 (6 lakhs) bales on the basis of the above enquiry Both IJMA and the Government of Bengal accepted this figure and used it in the two publications mentioned above

(2) *Quantity consumed from previous year s stock* The next step is to deduct the quantity consumed from previous year s stock from the total consumption during the year

According to an Act passed by the Government of Bengal in 1941 all jute mills jute balers and jute dealers have to submit a return showing the stocks of jute with them on the 30th June every year For several years there was a Special Officer (Jute) in the Government of Bengal in whose office these figures where compiled Actual figures were collected from the mills and balers and dealers of Calcutta and the neighbouring industrial area while estimates were prepared for the stocks held by muffasil dealers and growers on the basis of reports received from the District Agricultural staff

Calculation of consumption from previous year s stock

	1944 45	1945 46
	(thousand bales)	
(2 1) Stock at the beginning of the season		
(2 11) with IJMA mills	2 342	2 712
(2 12) with other mills	83	114
(2 13) with growers	466	150
(2 14) with muffasil dealers	816	475
(2 15) with Calcutta balers and dealers	643	575
total (2 1)	4 350	4,026
(2 2) Stock at the end of the season		
(2 21) with IJMA mills	2 712	2 604
(2 22) with other mills	114	105
(2 23) with growers	150	82
(2 24) with muffasil dealers	475	160
(2 25) with Calcutta balers and dealers	575	378
total (2 2)	4 026	3 329
Decrease in stock — (2 1) (2 2) =consumption of old stock during the year	324	697

(3) *Jute crop in other provinces* This is estimated by the respective Provincial Directors of Agriculture Plot to plot enumeration of the jute crop alone was undertaken in these provinces during the years 1939 43 and the subsequent estimates were prepared on the basis of the above plot to plot enumeration and local information obtained every year through the staff deputed for this work The figures for Bihar include the crop from Nepal which finds its way to the Indian market through Bihar The figures were taken from the *Final Jute Forecast*

SCIENCE AND CULTURE

A Monthly Journal of Natural and Cultural Sciences

Vol. 15 MARCH 1950 No. 9

HOLIDAYS AND VACATIONS

THE question of reform and re organization of education in this country is now before the Government and the nation The report of the University Education Commission, 1948 49, is under consideration of the Government of India, committees for secondary basic and adult education have been at work in the different provinces, and the setting up of a Secondary Education Committee on an all India basis is in contemplation This all out effort at solving the problem of education for our nationals is a happy augury for the future

It is proposed in this article to stress the necessity of reform in the timings of our school and college sessions, and of the imperative need of a careful planning for readjusting the working terms and the vacations in any academic year so that study may be carried on continuously without distraction or frequent interruption by short holidays This may appear to be a comparatively minor matter and has thus almost escaped the attention of our educationists and educators And yet it is an obvious truth that the efficiency of teaching depends upon our ability to provide the maximum number of working days interspersed with well planned holidays

In some parts of the country the school and college sessions are different In West Bengal, for example the school year is from January to December, while the college session is from June to May The result is that though the duration of the college course there is supposed to be six years, a student gets his Master's Degree at least 6 years 9 months after he finishes his 10 years' school course in December There is thus a wastage of 9 months to 1 year at the student's prime of life This is more or less true of other universities as well

Under the present system in the same province, a university examination is taken after 2 years' study between June and May In actual practice, June is taken up by the university in publishing the results of the previous examination, and July in registering admissions, and the college work begins in August It then proceeds till the College Test is taken in the second week of December next year Regular classes thus cease to be held by the middle of December though the university examination comes off in February/March next A course supposed to be of 2 years really extends over 16½ months at the most inclusive of holidays, vacations and examination period The conditions may be somewhat better in other provinces, but the overall picture is more or less similar

The period of study referred to above is again interrupted by different holidays, which differ from one university to another There is usually a long summer vacation of about 8 weeks duration,—which was initiated by the British who found the season to be too hot for work in the plains and which is now regarded to be of as great a necessity for ourselves as it was for our rulers It is also to be noted that while 4 to 5 weeks summer vacation is thought to be adequate for schools nothing less than 8 weeks recess will cool off the heated brains of our collegians and their teachers

There is again a large number of other holidays ranging from one day to one month or more These are mostly of religious origin —Hindu, Muslim Christian, Jain and Buddhist We have the Sundays, the Christmas holidays of about 12 days and the Easter holidays of 4 days on account of the Christians, a number of holidays for Muslim festivals (—and a comparison of such holidays now prevailing with those given some 10 years back, will show how the number of such holidays has increased considerably in colleges), and quite a number of holidays for Hindu festivals, at least one of which extends over 4 to 6 weeks As Mr Kapur wrote in a special issue of *Education* in 1941 on 'Holidays & Timings They are remnants of a time when life was a long holiday and there was little struggle for existence The Hindus and Musalmans do not lose their religion by opening their shops on most of these holidays , even those who are employed in Banks, Post offices, and the Treasury retain their religion for the fewer holidays they got ' In fact, the students as well as their teachers, excepting a microscopic few have hardly anything to do on these religious holidays and mostly idle away their time

The list is not complete We must have holidays both on the 1st of January as also on the New Year s Day according to the local calendar We must have a holiday on the Banks half yearly closing day altough schools are found to function on that day Numerous holidays are granted on account of birthdays or death anniversaries of eminent personages (—and the number of such holidays is increasing to an alarming extent—) the visits to the institutions of important persons and sometimes when people connected with the university get some honour or distinction In big cities the students take their own holidays when they organize a demonstration against some grievance real or fancied e g when the Principal takes any disciplinary action against some students may be in some other institution or the university refuses to entertain the students application for postponing the date of an examination Of late even the college teachers have begun to cease work as a record of protest against their treatment by the Government the educational authorities and the nation

To all these must be added quite a large number of working days taken for the conduct of university examinations in a college centre when the work of the non examinees has to be interrupted in many colleges In fact we have found that the number of working days excluding examination period in the Indian universities is generally not more than 120 to 130 per year and in some years it dropped down to as low as 100 days and a student gets barely 185 to 200 working days during his 2 years course

There might have been some justification for all those holidays if they had been planned on some educational principle and so timed as to ensure relaxation from intellectual effort just when it could be considered healthy But many of the religious holidays being of lunar origin they oscillate through a period of 35 days The confusion caused by these wandering holidays may best be illustrated by the Autumnal holidays in West Bengal This is timed by the Durga Puja the date of which varies from September 23 to October 21 so that the Autumnal holiday starts in some years from September 16 and in others as late as October 14 The same holds for the DEWALI holidays in Western India PANGAL in South India and ONAM in Travancore This is very inconvenient for teaching

The conditions in schools are somewhat better in respect of holidays referred to above But the timing of Annual Examinations in schools calls for some comment This examination used to be held in schools so as to end on the eve of the Christmas holidays and the results were announced on the re opening of the school on January 2 next year All schools now follow the practice recommended by the Department of Education —and the annual examinations for all classes (except the Test for the Matriculation) are over by the end of November Promotion lists are notified before the X mas recess On reopening in January, a few days are taken up by the Admission Tests for new entrants In many girls schools this is followed by rehearsals and preparations for the Prize Day There is thus no work for 6 to 7 weeks in schools

Let us now institute a comparison between the systems in the U S A and the U K and those in the different Indian universities in respect of working days

Universities in U K These generally work in three terms —October to December January to March and April to June X mas and Easter holidays average a month each in most universities and 5 weeks each at Oxford Cambridge and Durham There are no other holidays casual holidays are few perhaps averaging *3 days a year*

At Oxford there are 8 weeks in each term with 5½ days each week The total number of working days per year is thus 132 (8×3 5½)

At Cambridge the first two terms are slightly longer and the third shorter and the total number of working days is 151

In other universities there are 10 working weeks each of 5 days per term so that the number of working days is 150 At Durham 156 working days are provided

The confusion created by the wandering nature of the Easter has been removed by including the whole period between the extreme dates on which the Easter Monday may fall within the Easter holidays

Oxford and Cambridge have no examinations in the first two terms while other universities hold short terminal examinations for 2 to 3 days In all universities 12 working days in the third term are taken up by examinations

Universities in the U S A —America being a secular democratic country has not recognised any established religion and has thus discarded all religious holidays excepting the Christmas The only other national holidays are the Thanksgiving which is for 1 to 5 days and Washington s birthday

The studies in American universities are organized in two patterns the semester basis and the quarter basis the semester basis being the one more in vogue The working on the semester basis can be best illustrated by a reference to the programme of the University of Michigan for one year

1st semester —September 20 to December 16 and January 3 to Feb 5 the Christmas holidays extend from Dec 18 to January 2 there being only one other day s holiday for Thanksgiving on Nov 25 (See Appendix)

2nd semester —Feb 7 to June 11

Students may offer examinations at the end of any of these two semesters so that if he fails to qualify at one semester he loses only six months The examination periods in the year under review were—Jan 17 to 28 in the first semester and May 28 to June 9 in the second semester The total number of working days exluding Sundays, holidays and examinations was 91+88=179

The University Education Commission (India 1948 49) reports that the number of working days besides examination days at some of the American universities during the session 1948 49 were as follows

Harvard	172 working days
Pennsylvania	174 working days
Michigan	182 working days
✓ Johns Hopkin	188 working days
✓ Venderbilt	216 working days

Conclusion It is clear that under the system as now prevails in Indian universities our students work much less than the American or even British students and the standards attained are bound to be much lower On grounds of national efficiency this must be rectified and the number of working days must be increased to 170 to 180 exclusive of examination days To this end we recommend that

(*a*) As India is now a secular democratic State all religious holidays except the most important ones should be altogether abolished

(*b*) Holidays of longer duration which it may not be possible to abolish should not be allowed to wander but ought to be stabilised by including within the vacation the whole period during which the festival may oscillate Thus the Autumnal holiday in West Bengal should include the whole period between September *21* to October *31*

(*c*) The year should be divided into 3 well defined terms and the student allowed to take his examination at the end of the third term the compartmental examination if any being held at the end of the first term This will end all troubles consequent upon the uncertainties regarding the dates of the examination and or compartmental examination

(*d*) The number of other holidays in a year including all casual holidays and denominational holidays should not be allowed to exceed 10 days

It is difficult for us to prescribe a uniform system applicable throughout India and we would request each university to work out a system of its own on the principles recommended above For the State of West Bengal we tentatively suggest the following organization of sessional work (school term being from January to December students being sent up from the topmost class by November 15) —

1st term Feb 15 to May 15 (Compartmental Examination—May 20 to 31)

2nd term July 1 to Sept 20 (Autumn holiday Sept 21 to Oct 31)

3rd term Nov 1 to Dec 15 and January 7 to 31 (Examinations between Dec 20 to 31)

APPENDIX

UNIVERSITY OF MICHIGAN

CALENDAR 1948 49

FIRST SEMESTER

1948

September 1 Wednesday Last date for application for admission
September 15 18 Wednesday Saturday Registration.
September 20 Monday First semester classes begin
September 24 Friday Qualifying language examination for the doctorate
October 2 Saturday Last day for adding courses or for dropping courses without record
October 9 Saturday Diploma applications due
November 13 Saturday Last day for dropping courses
November 25 Thursday Thanksgiving day a holiday
November 29 Monday Doctoral dissertations due Applications for fellowships and scholarships available
December 17 Friday Christmas recess begins

1949

January 3 Monday Last date for application for admission.
January 3 Monday (morning) Classes resume
January 17 28 Monday Friday Examination period
February 2 5 Wednesday Saturday Registration for second semester
February 5 Saturday First semester ends

SECOND SEMESTER

February 7 Monday Second semester classes begins
February 11 Friday Qualifying language examination for the doctorate
February 15 Tuesday Last day for return of fellowship and scholarship applications
February 19 Saturday Last day for adding courses or for dropping courses without record
February 6 Saturday Diploma application due.
April 1 Friday Last day for dropping courses
April 1 Friday Spring recess begins
April 11 Monday Classes resume
April 18 Monday Doctoral dissertations due
May 28 June 9 Saturday Thursday Examination period
June 11 Saturday Commencement

SUMMER SESSION

1949

(Special course for part time students)

June 16 18 Thursday Saturday Registration
June 20 Monday Summer session begins
July 4 Monday Independence Day a holiday
July 29 Friday Six week courses end in summer session
August 12 Friday Eight week courses end in summer session

ROAD PLANNING FOR WEST BENGAL*

T MITRA

CHIEF ENGINEER WORKS AND BUILDINGS DEPARTMENT, WEST BENGAL

ROAD communications in Bengal were never really existent as such on any appreciable scale This will be appreciated from the fact that the total length of the roads in undivided Bengal was broken up into 226 independent isolated systems having no inter connection through metalled roads The breaks between the adjacent systems were caused either by wide stretches of country with no metalled roads or by unbridged rivers or streams Rapid growth of railway system also indirectly impeded proper development of roads owing to the operation of the principle that was universally accepted in those days that in order to avoid competition between the two systems of transport roads should not be parallel to the railways The Second World War however, helped the whole question to be seen in its true perspective and the principle was discarded It is now recognized that road transport is much better suited than railways for short haul traffic upto about 100 miles In this connection let me quote from an article in the January issue of *Transport Communications* monthly review —

> The inherent virtue of road transport is firstly its flexibility and secondly its lower capital commitments The flexibility of road transport arises out of its ability to effect deliveries from door to door and its being able to operate along tolerably good roads wherever available
>
> The motor vehicle does not need any costly fixed track to be laid down beforehand Its speed and manoeuvrability enables it to produce a rapid turnover Along a single lane route the operation of a sufficient number of motor vehicles can deliver the goods to an extent many times what railways along a similar length of track can do This feature enables motor vehicles to transport perishable and damageable goods expeditiously and without the risk of loss and damage which arise during the course of handling at the railway termini
>
> The implications of capital commitments are equally in favour of motor transport Fair motorable roads cost only a fraction of an equal length of railway track and similarly capital investment on a motor vehicle is much less than that on a locomotive or wagon The smaller capital cost implies greater opportunities to march with the times and discard outmoded equipment

In 1934 Mr A J King Superintending Engineer, was appointed to undertake an over all province wide planning survey and to submit a comprehensive report about the road requirements of the country (undivided Bengal) These reports in several volumes, were submitted in 1938, with a comprehensive scheme for a complete system of improved roads for undivided Bengal These reports are so thorough and complete that they are still serving as the framework on which the road communication system of the State of West Bengal, though so truncated, is being based

In 1929 the Central Government earmarked a portion of the revenues collected from duties imposed on petrol sales, for road constructions and created a Central Road Fund

From yearly allocations from this fund, which were extremely limited, a few vital road links were improved in this Province in the fourth decade of this century Then World War II intervened thereby causing almost total suspension of road activities, except on those required for transport of war supplies Towards the end of this war, the Provincial Government started studying and planning for road constructions on a much larger scale than had hitherto been contemplated The policy of avoiding rail road competitions was, as stated above, at that time changed into that of rail road co ordination, as a result of experience gained from war time transportations Detailed surveys were undertaken on many of the important arterial roads and feeder roads, on lines approved in the All India Chief Engineers' Conference held at Nagpur in 1943, popularly known as 'Nagpur Plan' But before actual works could be started on the scale envisaged at first political changes occurred resulting in the division of the Province into two

After the partition the railway system was greatly disrupted owing to the main Calcutta Siliguri line falling in Pakistan The navigation systems have also been considerably disturbed The areas near the new borders which were fed by roads leading to Pakistan were cut off and new roads were required to be aligned to give these areas the benefit of the railway system within West Bengal Apart from the necessity of effecting many changes of trunk routes or main routes the State was also confronted with a big and immediate problem in regard to subsidiary road system in border areas in order to re orient the traffic and trade towards practically opposite channels in Indian Union

Immediately after the partition the Department took up the matter of drawing up afresh a 20 year plan in consultation with District Development Committees This plan was completed in 1948 and it provides for the construction and re construction of nearly 13,235 miles of roads out of which 5 849 miles would be village roads and 7 386 miles would be of higher categories Roughly the scheme would cost nearly Rs 147 crores the high cost being due to high embankments generally required, poor quality of soil for road building purposes, scarcity of local materials suitable for road constructions and large number of major bridges required in the road system This plan would, however, require modification from time to time, according to the trend of growth of economic life of the country side The plan should, therefore, be regarded only as a target to be aimed at and would materialize with the growth of industries, agriculture, cottage industries and above all upto the extent of availability of funds

The first instalment of the road plan which was considered to be of immediate necessity has been taken up for execution as a 5 year programme This programme envisages construction of a number of roads of all categories, emphasis being given to those roads which would form the main arterial system. These are the national and provincial highways and district roads near the borders which though secondary in classification are considered as equally important. A few village roads also find place in the programme.

---

*Adapted from the Presidential Address at the Annual Meeting of the Institution of Engineers (India), Bengal Centre, held on February 10, 1950

Soon after the partition actual construction commenced initially on a small scale but with gradual increase in volume as time went on. Early in 1948 it was decided to establish practically a new and separate organization exclusively to undertake construction works on a substantially *large scale* all over the Province, as envisaged in the first 5 year plan. At the moment this new organization has more or less been established and most of the preliminary or preparatory works such as detailed surveys land acquisitions and collection of materials in advance have progressed fairly well. Unfortunately just now when we are ready and are capable of carrying out a substantial volume of works financial difficulties have arisen rather unexpectedly. It has now become necessary to cut down even our current programme rather severely. As an engineer I very much deplore this enforced reduction of road programme at a time when people become extremely road conscious and petitions from public demanding improvements of roads even outside our programme are coming in almost daily.

I should now like to say a few words regarding road communication system proposed in the first 5 year plan and *partly* included in the present programme of construction. Generally it is proposed that this communication system should be such as to allow proper functioning of several arterial routes running north to south as well as from east to west so that all parts of the Province would be served by motor vehicles. The main trunk roads are now classed as National and Provincial Highways according to their usefulness for inter provincial or inter district communications. Financially the maintenance as well as the new constructions required in connection with the national highway routes are the responsibilities of the Government of India whereas the provincial highways are entirely the responsibility of the Provincial Government. The areas between the trunk roads are to be served by such subsidiary roads which are termed as Major District Roads. All these categories of roads will gradually be improved into all weather standard fully bridged paved and drained. Other small feeders which are essentially fair weather roads would be classed as "Other District Roads" or Village Roads according to their usefulness to a large number of villages or to a smaller number. These latter roads will be mainly earth roads, which would have stabilized surfaces eventually. The bridges on such roads will also be of a semi permanent nature which would be gradually re constructed as and when necessary.

The State is now divided into three practically separate areas. The Northern Himalayan region is a completely separate area, connected to the Capital by the main Calcutta—Siliguri line which now lies in Pakistan. The alternative railway route via Sakrigali and Manihari Ghats and Katihar Jn. presents numerous difficulties and bottlenecks which it is hoped will be gradually overcome as a result of the emergency measures now being taken by the Government of India. The central part comprising the two districts of Malda and West Dinajpore has a common boundary with the southern part by a strip of nearly 20 miles across the Ganga. So far there is neither an all weather road nor a railway line directly connecting the central area to the southern districts. The extreme easterly point Balurghat which is the headquarters of West Dinajpore district is nearly 93 miles from Tildanga R. S. nearest point on the E. I. Railway system and is 60 miles from the nearest Station Kaliagunge on O. T. Railway.

The northern region has a fairly good road system existing within its borders but the establishment of an arterial route to connect this area to the rest of the Province is the most important need here. The Bihar Assam route which is N. H. 31 passes through this region from West to East. A section of this has been newly constructed from Bihar border towards Siliguri to replace the section which fell in Pakistan. Among other roads in the programme is Jalpaiguri Siliguri provincial highway which has been taken for improvement.

In the central region all navigable rivers such as Mahanadi Tangon etc. join Ganga and as a result transportation by boats has become impossible. There are proposals for the construction of railway lines joining Malda section of O. T. Railway with Balurghat by a branch line joining Raigunge on the Katihar Parbatipur line. But there is no knowing when the railways would be in a position to take up this programme actually. But even such lines will not solve all transportation problems as the bottleneck of the ferry crossing at Sakrigali Ghat and of congestions at Katihar will probably remain for some time to come. Moreover the distance from Malda to any point in south Bengal is increased by about 125 miles by such rail routes. For direct communication from Malda a bridge over the Ganga is necessary but that possibility cannot be taken as practical politics in the present state of affairs in view of the huge cost involved.

An arterial road designated as N. H. 34 and connecting Dhulian R. S. on the right bank of the Ganga with Malda and Gazol has just been approved for construction by the Union Government. This scheme provides for establishment of a power ferry from Dhulian to the opposite bank at Khejuriaghat and will thus open up direct communication with Malda District. It is also proposed that this route should continue towards Raigunge on O. T. Railway and then proceed to some point in Bihar eventually leading via Kishngunge to Siliguri. From Gazol the construction of a provincial highway to Balurghat is already in hand and this work has been given the highest priority. A branch road from this road will connect Kaliagunge R. S. and this also has been given a very high priority. All these roads when ready for traffic will make available a rail-cum road all weather connection between Calcutta and this area However in the southern districts of this Province there is no road connection at present between Calcutta and Dhulian R S and as such no through traffic is now possible to Maldah and northern areas The newly designated road N H 34 mentioned above will when constructed join Burdwan on the Grand Trunk Road with Dhulian R S via Morgram R S on Nalhati Azimgunge line and Raghunathgunge in Murshidabad This project has to be financed by the Government of India and there is bound to be some delay in the construction of this good length of road which would have to cross wide rivers such as the Ajoy and Mayurakshi To serve the present needs an alternative route is being developed as a provincial highway This route starts from Calcutta and is of all weather standard up to Krishnanagar Here there is an unbridged gap on account of Jalangi river which is to be crossed by ferries The next section between Krishnanagar and Berhampore is being improved under the present programme to an all weather standard From Berhampore this road follows existing roads via Jiagunge Bhagawangola and Lalgola upto Raghunathgunge situated on the proposed N H 34 This latter section has also been taken over for improvement Thus in course of next 2 or 3 years it might be possible to ply loaded trucks between Maldah and Calcutta in all weather

All sections of roads mentioned above coming under category of N H and P H are vitally necessary for establishment of road communication between three areas of this State provided the length within the Bihar boundary is also completed simultaneously Besides these there are a few roads leading to the borders of Pakistan which are of equal importance for reasons explained such as

(i) Berhampore to Jalangi—Murshidabad district	
(ii) Plassey to Betai	Nadia district
(iii) Krisnanagar Karimpur Sikarpur	
(iv) Bongaon to Badga and Boyra	24 Parganas
(v) Basirhat Hasnabad Hingalgunge	

Improvements on these roads are already in progress under priorities scheme

Besides the above the importance of other existing roads and ferries and construction of new roads to open up new areas for purposes of economic developments and rehabilitations cannot be ignored and the 5 year plan programme includes several such alignments for construction and improvement I may mention here a few such road alignments

(1) Diamond Harbour to Kakdwip—to give road connection to the Sundarbans
(2) Sainthia on the Loop line to Berhampore
(3) Contai Road Station to Conat and Digha
(4) Baidyabati—Tarakeswar Champadanga
(5) Howrah to Uluberia leading to Kulaghat and Midnapore

In the first 5 year plan national and provincial highways to be constructed will total more than 675 miles major district roads over 1200 miles and other district and village roads over 300 miles Construction of a dozen major bridges are also contemplated The total cost of this scheme calculated at present market rates is approximately 26 5 crores on account of the Provincial Government Programme of construction of national highways of course depends upon funds to be allotted by the Government of India

While the main highways and district roads will be provided for through traffic to cities and markets feeder roads are required to serve villages It will of course not be possible to construct all weather metal roads to every village from Provincial funds Hence alignments have to be so chosen that with minimum mileages improved it will be possible to serve maximum number of villages and people This will also require as basis an economic study of the areas where feeder roads are proposed to be provided But once arterial roads completed more and more village roads can be taken up for consideration

In the framework of the road system proposed to be developed according to the first 5 year plan there are many existing roads which are maintained by District Boards These are being taken over for improvement and maintenance as provincialised road Many such roads scheduled for improvement have no side lands and it is most unfortunate that houses have been built up along carriageways thus making those roads dangerous to any fast traffic In such cases either road side structures and lands have to be acquired or it will be necessary to provide necessary diversions in more open areas The abandoned section of a road has to remain under the District Boards or Local authorities for maintenance as before Such diversions of routes even in very long lengths will be necessary for almost all national and provincial highways to be improved

This Province is a land of rivers and ferry services have been a source of inconvenience and a bar to the the growth of highways traffic These ferries are generally leased out to contractors who are responsible for providing boats and for management It is now under consideration as to how this unsatisfactory system can be improved It is hoped that management of the ferries falling on the roads taken over under Government control will also be transferred to this Department It might then be possible to improve approaches and provide boats of adequate capacity so as to take across fully loaded trucks and cars Where necessary power crafts will be operated to shorten time taken for the crossing

As already mentioned the first 5 year plan is being severely cut down to meet present economic difficulties However to expedite construction and to overcome bottlenecks existing with regard to supplies transportation and labour to some extent a fair number of water-crafts, mechanical equipments etc have been procured Employment of machineries for earth moving for road works is a new innovation at least in this State and is proposed to be taken up here on an experimental basis It is believed that if these heavy machines can be properly organized and operated cost of earth works can be substantially reduced For road works we have to depend mostly on imported labour which is limited in extent and is expensive in relation to their capacities But the extent of mechanization also depends on the establishment of an efficient organisation to maintain the machinery

Specifications for roads will follow the standards laid down by the Indian Roads Congress The metal crust of the roads will provide for single traffic line (12 ft wide generally) for the present The composition of the hard crust will depend on the anticipated traffic

A beginning is also being made with regard to planning new surveys such as survey of populations agricultural and industrial activities etc in various regions of the State Such surveys obviously will take a long time but when completed will give a wealth of information and a correct estimate of eventual requirements of roads in the Province

We are really just at the beginning and I do not know how much can be realized in the near future But I feel certain that if money and supplies are made available, we can do much more Unfortunately when ever there is financial stringency financing of roads becomes the first target for retrenchment It is not generally realized that construction of fair motorable roads is not a financial liability As a matter of fact except during 1944 and 1945 the yearly expenditure on roads in the 14 years from 1933 to 1946 was much less than the total revenue from motor vehicles The revenue (for the whole of India) during these years was 14,276 48 lakhs and the expenditure 11 284 89 lakhs i e , a contribution of nearly 30 crore was made to the Exchequer by the Motor Transport It is clear therefore that if an inadequate road system with its existing breaks and bottlenecks can contribute so much an adequate road system without such breaks and disabilities can contribute very much more in the shape of direct revenue without taking into account other indirect benefits contributing to the happiness and prosperity of the people In this connection may I quote the wise words of Mr Thos H Macdonald who, for more than two decades has been the head of the Bureau of Public Roads in U S A

> A country pays for its roads whether
> it has them or not and it pays more
> if it does not have them '

CINCHONA FINDS A NEW HOME

R CHATTERJEE
PRESIDENCY COLLEGE CALCUTTA

SIXTY five species of Cinchona, all indigenous solely to South America are ever green trees which in the wild state usually grow singly and reach a height of about one hundred feet They occur on the slopes of the Andes, Columbia Ecuador, Peru and Bolivia at an altitude of 4000 7000 ft The natural distribution of the more important species is as follows

In Columbia grows mainly *C lancifolia* Mutis in Ecuador, *C officinalis* L , in Peru, *C officinalis* L *C succirubra* Pavon and *C micrantha* Ruiz and Pavon and in Bolivia *C Calisaya* Weddell and *C Ledgeriana* Moens

The Governments of these countries levied a duty on the bark collected and exported For nearly two hundred years supplies of the bark were obtained from the forest of Loxa on the border of Ecuador and Peru, by felling the trees and stripping off the bark No trees were planted in places of the trees destroyed and to meet the demand, the area of the collection was extended, with the result that a shortage developed until the middle of the nineteenth century and cultivation of Cinchona became imperative

During this period the British and the Dutch Governments were the largest buyers of Cinchona barks and of Cinchona febrifuge prepared from them In Bengal alone, not to speak of other tropical parts of India a quantity of two thousand pounds or more of quinine sulphate was required in a year

TABLE 1

THE QUANTITY OF QUININE SULPHATE SUPPLIED TO THE MEDICAL DEPOTS DURING THE MIDDLE OF THE NINETEENTH CENTURY

Year	Quantity in lbs
1867	1083
1868	2117
1869	2068
1870	3460
1871	1696
1872	1760
1873	2606
1874	5524
1875	3037

In view of the scarcity of the drug and increase in price, both the Dutch and British Governments thought seriously over the cultivation of Cinchona plants in their own territory As early as 1835, Royle, the then Superintendent of the Botanic Garden, Saharanpur suggested to the Government of India to introduce Cinchona on the Khasia and Nilgiri Hills but those who were in authority did not pay much attention to his proposal Twelve years later Royle put up the proposal again and after six years reminded of it and in 1856 repeated the same proposal once again He was supported by Grant, the Apothecary General to the

East India Company and Falconer the Superintendent of the Botanic Garden Sibpur who brought similar proposals in 1850 and 1852 Falconer went further to suggest that a plant hunter should be sent to the mountains of South America for collecting a stock of young Cinchona plants and seeds of all good species Falconer s successor pressed the point again in 1855 The Dutch were a little more up and doing and the Dutch Ministry sent in 1852 their plant collector Hasskarl to South America who came back with a large number of seedlings of Cinchona which when grown were found to be not of much value for the production of quinine

The British Government arranged as late as 1858 to send Markham for this expedition A few seeds of *C Calisaga* were obtained in the mean time by Royle from Heddell a surgeon who accompanied a French expedition to South America These seeds were brought to Sibpur where they failed to germinate Samples of seeds which were sent to Kew and Edinburgh germinated and six seedlings were sent to Darjeeling in 1853 of which three arrived alive and died soon after

Markham had a knowledge of Spanish as well as of the dialect of the people of a district where good species of Cinchona grew He knew the people and the country and he organised his expeditions which began their work early in 1860 He collected about five hundred plants of the valuable species *C Calisaya* from the Tambopota valley of the Andes the climate of which is moist for it rains heavily there for about five months in a year *C succirubra* was collected from the Red Bark forests and seeds were brought to India by post and the plants were sent to the Nilgiri Hills in 1861

With due consideration to the habitat of Cinchona plants it was settled that Cinchona cultivation should be tried in the Nilgiri Hills and a plot of fifty acres was prepared for the first Cinchona experiments in India The *Calisaya* plants unfortunately arrived in a dying state and not one of them struck root The *succirubra* plants and six *Calisaya* plants which had been raised at in Kew 1862 reached India in good condition As regards the choice of site Markham thought the Nilgiri Hills to be highly suitable He did not visit any part of the Himalayas or Khasia Hills which were suggested long ago by Royle and Falconer The Sikkim range of the Himalayas appeared to be of suitable climate for growing Cinchona In 1861 Anderson the Superintendent of the Botanic Garden Sibpur received some Cinchona seeds from Sir W J Hooker He produced about thirty plants from them He was sent to Java to acquaint himself with the Dutch mode of cultivation and to bring to India the plants which the Dutch Government offered us He brought with him about four hundred plants and a quantity of seeds of *C pahudiana* On his way he brought to Sibpur about two hundred plants of *C succirubra* from the Nilgiris Some of the Java plants died in Sibpur and about three hundred plants which survived were brought to Darjeeling in March 1862 Anderson thought that the Cinchona plants would need plenty of rains and cold weather and selected a spot near the top of Senchal a height of 9000 ft where on the first day of June 1862 about two hundred plants were placed and to the great joy of the experimenter they thrived very well for about five months but December weather was too severe for them and Anderson thought it wise to remove them to Lebong a place warmer than Senchal and at an altitude of 6000 ft On the first of April of the year following the entire stock of Cinchona plants were removed to Rungbee valley twelve miles from Darjeeling town on the south east slope of Senchal range at an elevation of 4500 ft for permanent plantation Fresh stocks of *C succirubra* *C Calisaya* and *C officinalis* obtained from the Nilgiri were planted there

Those were pre railway days and there were obvious transport difficulties the climate of Darjeeling was much more vigorous than it is now Anderson faced unforeseen difficulties He could not get suitable land nearer than twelve miles from Darjeeling town and to reach this spot an almost impenetrable forest had to be passed through requiring every step to be cleared of the thick under growth He hoped that the permanent propagating houses the gardeners house and huts for the porters would be finished in three months Instead of which it soon appeared that until a bridle path eight miles long could be finished the building could not even be started and that two years appeared to be the shortest time in which they could be ready He could not get temporary buildings except barracks on the windy and cold crest of Senchal Flower pots were unknown at Darjeeling and so they had to be obtained from Calcutta Even white river sand was not available accordingly a maund of sand had to be brought from the Botanic Garden Sibpur During then parcels from Calcutta never reached Darjeeling in less than six weeks The nursery at Lebong was abandoned in April 1865 one was opened at Rungeroong and in June 1864 about five hundred plants were cultivated in the Rungbee valley

Rungbee became the head quarters of the cultivation and a search was made for a suitable elevation and place for the plantation One patch of land was selected at an altitude of 5 321 ft others at 5000 3332 and 2556 ft and towards the end of the year 1865 an experimental station was formed in the Teesta valley at an elevation of only 1000 ft By 1886 about six thousand plants were put in the Rungbee plantation and the total stock amounted to about 179000 The Nilgiri plantation went much ahead of it with about a million and a half of plants of all ages of which 40000 were in permanent plantation

It was found that *C Calisaya* thrived very well in Darjeeling By the 1st of April 1875 a considera-able number of 354000 trees of the said species were in the plantation *C succirubra* was found to be hardier and could be propagated much more easily Of the species brought first to Darjeeling C *pahudiana* proved worthless and its cultivation was subsequently abandoned The total expenditure from the beginning of the cultivation in 1862 till 1874 was Rs 6 46 243 as against the total income of Rs 7 958 mostly by selling plants, and till 1874 the plantation was practically not exploited for revenue

TABLE II

INCOME AND EXPENDITURE IN Rs OF CINCHONA CULTIVATION IN DARJEELING FOR THE FIRST THIRTEEN YEARS

Year	Income	Expenditure
1862		9455
1863		10421
1864		39096
1865		59063
1866		48964
1867	1068	67601
1868	543	75965
1869	156	54542
1870		54576
1871	1484	60023
1872	2320	50795
1873	2387	55620
1874		59942
Total Rs	7958	Rs 646243

The following Tables III and IV shows different places in India where Cinchona cultivation were attempted and the optimum conditions for growing Cinchona Of these areas Bengal and Madras have the cultivation upto the present times

TABLE III

PLACES WHERE CINCHONA CULTIVATION WERE ATTEMPTED

Madras	The Wynaad district	N W Provinces	Saharanpur
	S Canara		Dehra Dun
	Ganjam		Mussorie
	Coorg		Garhwal
	Nulla Mully Hills		Kumaon
	Travancore		Raneekhet
	Pulney Hills		Urkulli
	Tinnevlly Hills		Kangra Valley
	Shevaroy Hills	Burma	Bogalav Hills
	Nilgiri Hills		Mergui
Bengal	Mungpoo	Bombay	Mahabaleswar
Assam	Khasia Hills	Ceylon	

TABLE IV

OPTIMUM CONDITIONS FOR GROWING CINCHONA

1 Cool climate
2 Temperature 40° to a maximum 80°
3 Rainfall 100 to 130 inches
4 Altitude of the plantation 4000 ft and lower
5 Good drainage
6 A deep vegetable loam with a good subsoil

By 1898 the plantation at Rungbee valley extended to Mungpoo In 1888 arrangements were made to manufacture quinine over 300 lbs were made that year Table V shows that the output of quinine gradually increased in recent years together with the net annual income of the Cinchona factory in Bengal As the demand for quinine increased a new plantation was begun in 1900 at Mungpoo east of Teesta Valley

In India the cultivation of Cinchona has been influenced by two factors the difficulty of growing *C Ledgeriana* under local conditions and the demand for mixed alkaloids of the bark rather than quinine alone Usually the plants are grown from seeds and the seedlings when about six months old are planted out from nurseries Until the fourth year there is little bark and the alkaloid content is low Grafting methods are also used plants are selected from the nurseries and grafted on the old stock In Darjeeling *C Ledgeriana* supplies the bulk of the crop but in the less favourable situation Ledger Hybrid (*Ledgeriana*× *succirubra*) is grown because although the quinine content is less it produces a more robust tree Small quantities of bark are also obtained from *C succirubra* *Ledgeriana* × *officinalis* hybrid and the so called *C robusta* Howard *C robusta* is not a definite species of Cinchona It is a hybrid between *officinalis* × *succirubra* or may be as some say between *officinalis* × *Calisaya* It grows luxuriantly within a wide range of elevation and temperature

TABLE V

ANNUAL PRODUCTION OF QUININE AND NET INCOME OF THE CINCHONA FACTORY IN BENGAL

Year	Quantity (in lbs)	Income (in Rs)
1936	20839	652723
1937	14019	831818
1938	16525	941616
1939	16025	895020
1940	18922	1391945

TABLE VI

PERCENTAGE OF THE MAIN ALKALOID CONSTITUENTS OF CINCHONA BARKS

	Total alkaloid	Quinine	Cinchonidine	Quinidine	Cinchonine
C Ledgeriana	5–14	3–13	2 5	0 5	1 5
Ledgeriana succirubra	6–12	3– 9	3 0		1 5
C succirubra	4 5–8 5	1 3	5 0	0 3	2 5
C robusta	6– 8 5	1 8	6 5		1 0

Although the net profit of the Bengal plantation alone shows quite a tempting figure yet comparing figures of production in India and Java we are compelled to admit that starting about the same time and with practically the same opportunity in both countries Java now produces well over 90 p c of the world s supply of Cinchona bark and India only about 4 p c The quantity of Cinchona produced in India represents only about one third of the amount actually consumed under present condition in India itself The position therefore, is that India the only Cinchona producing country of consequence other than Java makes no attempt to supply even the needs of her own and looks to Java for help It appears that in India the lowest amount of quinine which will have any effect upon her malaria problem will be about 970000 lbs This estimate is based upon a consumption of only 20 grains per head per annum

THE CONCEPT OF ENGINEERING NEUROLOGY

S K GHASWALA
BOMBAY

AMONG the various established fields of engineering science the most fruitful areas of development are those which fall into no man's land These boundary regions mainly remain unexplored owing to the fact that there are few investigators who combine in themselves the training of a number of sciences such as for instance medicine, engineering and mathematics, and who can deal with solution of complex differential equations with the same ease as the evaluation of functional disorders of the human mind At present there is one borderline science which has been taken up for investigation *viz* the science of control and communication in the entire fields of biology and engineering Outstanding amongst the investigators of this field is Dr Norbert Wiener, Professor of Mathematics at the Mass Inst of Techn, U S A , and one of the world's top ranking mathematicians Educated at the Universities of Cambridge, Harvard, Columbia, and Gottingen, Dr Wiener, in addition to being a mathematical analyst, is a brilliant linguist, philosopher and literary scholar With a thoroughly consolidated mathematical background Weiner has stepped into the field of biology to study the working of the human nervous system and to connect it with the working of computing mechanisms, for it has been amply demonstrated that their exists common elements both in the functioning of automatic mathematical and engineerng machines and the nervous systems of living organisms In order to signify this new science, in a compact form, Wiener, in collaboration with his colleagues, especially Dr Arturo Rosenblueth of the Institute Nacional de Cardiologia of Mexico and formerly of the Harvard Medical School decided to coin the word Cybernetics', to designate the entire field of control and communiation theory both in living organisms and in engineering mechanisms This word is taken from the Greek "kybernetes' (κυ—βερνητηS) meaning "steersman," It may interest the student of philology to know that from the Greek word through the Latin corruption "gubernator" came the term "governor", which has been used to designate a certain type of control mechanism This was in fact originally described by that great English scientist, James Clerk Maxwell[1] in 1868 in a brilliant paper which is today looked upon as the forerunner of the feed back mechamism principles The justification of the importance of this vast field of engineering neurology on the map of communication engineering is evident from the fact that after over ten years' work, Dr Wiener has now published a book on Cybernetics—which as far as the writer is aware is one of the very few texts to be written on this subject[2] Those interested in physical sciences may well stretch back their memories to some three decades when Sir D'Arcy W Thomson[3] first published his monumental work on the relationship between physical and mathematical aspects of growth and form in plants and animals, and showed that the form of any portion of dead or living matter can in all cases be ascribed to the engineering conception of the action of force In as much as that work fell within the general field of biomathematics, the work of Weiner on cybernetics falls in biomechanics in which the feed back and oscillation mechanism of the computing machines is linked up intimately with the physiology of living matter and its nervous system

GENERAL CONCEPT OF CYBERNETICS

The study of cybernetics appears to have very wide potentialities as its applications may range from the design of control mechanisms for artificial limbs to the almost complete mechanisation of industry In addition to this it forms a method of probing into the working of the human brain through the development and construction of complex mathematical machines The first industrial revolution brought about the devaluation of the human arm by the competition of machinery The present technological revolution is similiarly going to devalue the human brain in its more routine decisions and work

In communication engineering unlike power engineering the main emphasis is not on economy of energy but on the accurate reproduction of a signal This may either be for opening a door by means of photo cels, or to point the muzzle of a gun in the direction in which a radar beams picks up an airplane or for the solution of differential equations

The engineering of the human body is looked upon by one school of thought as belonging to a branch of power engineering, while the other school maintains that it forms part of communication and control engineering Today it is being realised that the body is very far from being a conservative system and that its components work with power which is much less limited than originally comprehended The importance of the physiological application of feed back principle arising herein is evident in the continuation of life in what is termed homeostatic mechanism Thus the neurous, which are the atoms of the nervous complex of a body carry out their work in practically the same manner as a vacuum tube, the relatively small power being supplied by the circulation These neurous or nerve cells show complicated properties under the influence of electric currents, but act as ideal relays under physiological actions In fact a nerve can be looked upon as a relay with two states of activity *viz* "firing" and 'repose" There is first an active phase transmitted from one end of the neuron to the other with a finite speed, followed by a refractory period during which a neuron is incapable of being physiologically stimulated After this refractory phase is over the nerves get inactive, but can be stimulated again into activity In a computing machine the main structure is of a bank of relays which either "fires off" or "reposes" corresponding to some such condition of "on" and "off".

not console private motor car and transport vehicle owners and industrialists of the country

Just now molasses has again become surplus in India and undoubtedly will continue to be so Fuel technologists do not usually get training in high level researches in organic synthesis therefore co ordinated efforts headed by synthetic organic chemists seem to be reasonable to research for production of motor and aviation fuel Amongst possibilities (1) ethyl alcohol from molasses and *mohua*, and (2) products of wood distillation from forest wood need careful consideration Long term policies have to be thought out and worked up step by step By organized and planned developments molasses may be developed easily as a bye product from sugar factories and *mohua* may be grown in course of grossly neglected forest regeneration Cost price of ethyl alcohol was about four annas per gallon before, and it can be easily brought down to that level by normal efforts Having based on the production of ethyl alcohol at normal cost experiments have to be varied for example ethylene produced from it may be polymerized and thereafter different processes of cracking have to be adopted to get ultimately some molecules as effective as iso octane

Wasteful methods of wood distillation was done in Mysore If however, the entire process is done correctly, then ingredients necessary for production of synthetic petrol are all plentifully obtainable from wood distillation, quite similarly as those from coal By making use of wood tar and a suitable catalyst it is reasonable to expect usual hydrogention of carbon atom from wood or charcoal Ford Motor Company of America get about 20 percent by weight of inflammable gas at no additional cost This gas is quite rich in methane and its production is expected to increase by suitable variation of technique of wood distillation Our whole country is full of unlimited forest area though grossly neglected. Bye products of wood distillation may be converted with advantage into motor and aviation fuel

Research laboratories in organic chemistry may now think on similar lines as above and formulate probable avenues of commercial success leaving aloof fuel technologists to reproduce hyrogenation of coal for defence purposes irrespective of cost of production and normal trade competition It is quite serious that owners of private cars and transport vehicles and industrialists need not expect any relief from Indian coal under the planned arrangement for production of oil from coal, from economic aspects

J N RAKSHIT

Calcutta, 3 4 1950

---

[1] SCIENCE AND CULTURE *15* 64 1949

[2] Dutta Roy, R K Ind New End *Jour Ind Chem Soc* *28* 1949

[3] Stuart, E R *Journal & Proceedings, Royal Institute of Chemistry*, Feb 1949, 29

[4] Gaitskell, *ibid* p 15

[5] M. Berthelot, *Compt. Rend* *67*, 1868

SEARCH FOR NEW ANTIBIOTIC PRODUCING FUNGI FOR CONTROLLING PATHOGENIC ORGANISMS

The recent discovery of a large number of antibiotic substances from the metabolic products of micro organisms tends to support the view that it is quite possible to search for newer types of antibiotic-producing organisms from their natural habitat Extensive work on this line has been carried out in U S A and Great Britain and an enormous array of literature have accumulated during the last decade These have been reviewed by Duemling *et al*[1] Waksman[2] Benedict and Langlykke[3] and Bailey and Cavallito[4] Already there are more than hundred different compounds isolated from micro organisms and there is sufficient evidence to believe that a great many others can be obtained, if the organisms are studied in greater detail There are various methods of approach to this problem and the method suggested by Waksman[2] has been followed in the present investigation

Cultures of fungi were isolated from various sources, *viz* soil compost and vegetable waste by plating with Waksman s acid agar medium The isolates were grown in subculture and were subjected to rapid screening tests as suggested by Raper *et al*[5] and a primary selection of the positive antibiotic producing strains was made Of 540 isolated fungi 139 were found to be capable of producing inhibitory substances These are mostly species of *Penicillium* or *Aspergillus* and a few strains of *Fungi Imperfecti* The activity of 20 better antibiotic producing strains are reported in the present communication

TABLE I

Cultures	Diameter of inhibition zones (mm) of test organisms			
	Staph aureus	*E coli*	*V cholerae*	*Eb typhosa*
P_4	28	20	0	0
136	30	30	30	30
F_1 (10)	16	17	0	16
F_2 (20)	20	20	0	17
F_3 (43)	12	16	0	17
IF_4 (54)	23	18	12 5	14
FX_2 (63)	16	14	0	17
F_6 (64)	18	13	15	17
FX_1 (64)	25	13	13	13
F (66)	21	0	0	0
FX (68)	15	15	0	21 5
F_2(69)	24	0	0	0
F_2 (70)	26	10	0	0
F_1 (71)	24	0	0	0
F_3 (71)	30	9 5	0	0
FY_2 (71)	30	10	0	0
F_5 (82)	25	0	0	0
FX_3 (82)	28	0	0	0
F_3 (83)	23	0	0	0
F_4 (83)	19	11 5	9	9
Phenol(5%)	26	22	20	22
Mercuric Chloride (1 500)	30	22	25	24

The cultures were grown in modified Czapek Dox solution with 0 2% malt extract for 10 days at 24°C

The culture fluids were assayed according to the agar-cup method using 4 test organisms—*Staph aureus*, *E coli*, *V cholerae* and *Eb typhosa* and the results are given in Table I

The selected test organisms were all human pathogens, of which only *Staph, aureus* is Gram positive and the remaining three are Gram negative It will be seen from the table that the antibiotic producing organisms used in the above experiment, show a wide specificity in their antagonistic activities It is remarkable that *Vibrio cholerae* is the least sensitive amongst all the test organisms as in this case the inhibition zone was observed only in 5 instances *Eb typhosa* and *E coli* were inhibited in 10 and 14 cases respectively while *Staph aureus* was inhibited in every case

One strain of *Penicillium* (No 136) was found to be effective equally against Gram positive and Gram negative test organisms, and the zones of inhibition produced here were highest amongst all the active cultures employed in this experiment Arrangements are now in progress to test the toxic effect of the purified preparation of the active substances in experimental animals and a detailed investigation on the method of improvement of production of the antibiotic agents will be reported in future

S K MUKHERJEE
S SEN
P N NANDI

Section of Microbiology,
Bose Institute
Calcutta 19 5 1950

[1] Duomling W W *et al Ann New York Acad Sci 48*, 31 228, 1946

[2] Waksman, S A, Microbial Antagonism and Antibiotic Substances, 1947

[3] Benedict R G and Langlykke A F, *Ann Rev Microbiol*, *1*, 193 236 1947

[4] Bailey, J H and Cavallito, C J *Ibid*, *2* 143 182, 1948

[5] Raper *et al Jour Bact*, *48* 644 45 1944

SUNSPOT ACTIVITY AND COSMIC RAY DISTURBANCES

It was reported in *Nature*[1] that "a big group of sunspot brought into view by the sun's rotation on the 14th February will cross out of sight on Feb 27 In Northern latitude 11°, the centre of the complex group crossed the meridian on February 20 2 U T This group will probably have not been exceeded in size since 1947 (the peak year of the present 11 years sunspot cycle) when the outstanding group had an area nearly double the present Judging from the size alone the present group is likely to be associated with geomagnetic and ionospheric disturbances"

The results of cosmic ray intensity measurements during the period February 17, to March 2, 1950, carried out in the premises of Bose Institute, Calcutta by one of us (*I L C*) is a continuation of the investigations reported earlier by Chakraborty and Chatterjee on cosmic ray intensity measurements by means of a pressure ionization chamber The apparatus used is the same as described in the latter communication[2] and the results are given in Curve I, one of us (*P K S C*) while engaged in an investigation on the nature of secondary radiation produced by cosmic rays in different thickness of lead, noticed on 28 2 50 an increase by almost one hundred per cent in the frequency of coincidences in a counter telescope placed under 10 cms of lead The curve representing the variation in frequency of coincidences with time on 28 2 50 is given in Curve II The counts were taken for one hour intervals

In table I appended herewith we have collected together all data available for the present on (*i*) the number of sunspots visible on different dates at Kodaikanal and the position on the sun's disc of the large group of sunspots as reported in *Nature*[1], (*ii*) solar flare observed at different places, (*iii*) radio fade out observed by A I R in Delhi, (*iv*) magnetic storm as recorded at Kodaikanal and (*v*) variation in cosmic ray intensity as recorded at the Bose Institute, Calcutta It may be mentioned that the pressure ionization chamber was installed in an air conditioned room on the roof of the main building of the Bose Institute and the coincidence counter arrangement was housed in a hut in the garden at a distance of over 100 yds from the former

Table I

	13	14	15	16	17	18	19	20	21	22	23 25	26	27	28
NUMBER OF SUNSPOTS	74	116 [illegible]	139	166	131	118		[illegible]	153	150			[illegible]	
SOLAR FLARE					[illegible]					[illegible]				
RADIO FADE OUT			[illegible]						[illegible]					
MAGNETIC STORM			[illegible]	← [illegible] →			[illegible]	[illegible]	←	[illegible]	[illegible] →	[illegible]	[illegible]	[illegible]
COSMIC RAY INTENSITY					[illegible]			[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

The principal points of interest elucidated from Table I are discussed below

(*i*) The relative number of sunspots which were observed at Kodaikanal increased from 74 on 13th Feb to 116 on 14th, the date on which the large group of sunspots mentioned in *Nature* appeared on the surface of the sun's disc, on the 15th the number increased to 139 which coincided with a complete radio fade out observed at Delhi between 11 55 to 12 55 hrs I S T On the 15th a slight disturbed magnetic storm was also observed at Kodaikanal (*ii*) On the 17th a solar flare of intensity 2 was observed at Kodiakanal between 02 10 to 02 44 hrs I S T In curve I, there is an indication of diminution in cosmic ray intensity with a minimum of about 1 82% at 16 hrs I S T There was however, no magnetic storm, the Kodaikanal report states calm from 16th to 18th Feb and on the 19th it was slightly disturbed (*iii*) According to *Nature* the centre of the complex group of spots crossed the meridian on Feb. 20 2 U T. In our record there is a sudden

They are actuated by some central mechanism which directly works them or their action held up, until all the relays have gone through their steps

SERVOMECHANISM PRINCIPLES

In a manually controlled transmission it is necessary to observe the output and input and adjust the control so that the actual output is kept as near as possible to the desired output A mechanism which automatically feeds back a signal from the output and maintains this difference as small as possible is termed a servomechanism[4]

Servomechanisms may be optical electrical mechanical hydraulic pneumatic or a combination of these all of which have three main aspects These are (*i*) stability depending on the power amplification from the source of energy (*ii*) transient response *i e* its response to the applied signal and (*iii*) steady state error *i e* the error subsisting an indefinitely long time after the application of a signal Many instances today arise in engineering where these feed back principles are effectively used Thus the ordinary thermostat which regulates the temperature of a building or a theatre is an example of negative temperature stabilizing feed back Similarly the governor of a steam engine is a velocity stabilizing feed back while position stabilizing servomechanisms are found in steering engines of a ship in which the actuation is obtained from the angular difference in the positions of the wheel and of the rudder

According to Wiener[2] human voluntary activity is of this nature Thus the movement of muscles is not always willed in fact which muscles are to be moved to accomplish a certain task is not always known Our motion is regulated by some measure of the amount by which it has not yet been accomplished Considering a case of say lifting a piece of article the fingers of the human body with their large number of joints go into play Because the output is an additive vectorial combination of the outputs of all the joints of the fingers a single feed back system cannot stabilize a complex additive mechanism Thus the feed back by which we regulate the performance of the task through the observation of the amount by which it is not yet accomplished needs the support of other feed back systems These are termed postural feed backs and are associated with the general maintenance of tone of the entire muscular system These postural feed backs are more or less akin to the mechanisms employed in the computing machines

COMPUTING MACHINES

Computing machines like slide rules and the ones used in banks and offices for addition subtraction multiplication and division are common to many More complicated than these are the differential analysers originally conceived by Leibniz[5] later revived by Lord Kelvin[6] and finally put into their refined form by Bush in 1931 at the Mass Inst of Technology[7] Among other such computers mention may be made of the Electric Analog Computer at the Cal. Inst of Technology U S A used for evaluating earth quake stresses for structures of any degree of freedom[8] the electronic digital computer operated at the Ballistics Research Lab Mary land U S A[9] for aerodynamic problems like the flow in compressible boundary layers and for computations of supersonic flow field and other similar types now in use at Cambridge Manchester, Oslo and Leningrad A typical electronic computer is shown in Fig 1 These machines which are usually electrically operated carry out the computations of complex differential equations within a very short time In order to give exact solutions a set of complicated relay arrangements and servomechanisms are incorporated in these analysers These machines are not just mechanical gadgets moving to and fro like a locomotive or an automobile but possess memory in the sense that they preserve the results of past operations for use in the future They are thus similar in their working to the human brain not only in their physical structure but in the instructions and data feed into them and the additional information stored and gained during all the operations[10] The point of difference is that a differential analyser is intended for many successive runs with a minimum reference to each other and that it can be cleared between such runs whereas the human brain never clears out its past records This fact has led Wiener to postulate

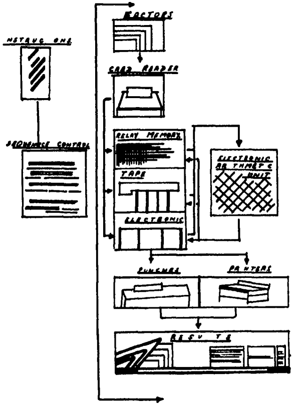


Fig 1 Selective Sequence Electronic Calculator—built by the International Business Machines Corporation, U S A (*Sc Am* 11/48 49)

the importance of this subject in psychopathology and psychiatrics[8] He asserts that the distinction between functional and organic disorders can be more clearly interpreted from a consideration of computing machines In fact mental disorders are fundamentally diseases of memory of the circulating information kept by the brain in the active state and of the long time permeability of synapses Similarly disorders in an analyser arise from the tooth of a gear wheel slipping off or by an electrical arrangement going into a circular process with no apparent way of stopping it These defects can be remedied either by restarting the machine after clearing it of all the past information or sending very large electric impulses or at worst disconnecting the part and using the machine without that component or replacing it if possible The more malignant disorders are however treated as in a computing machine either by shocks or by surgical operations generally termed prefontal lobotomy

In addition to the mental disorders caused by physical injury the overloading of routes in the brain also produce such effects These functional limitations correspond to the common engineering limitations as well Thus the dimensions of a building are limited by the bearing capacity of the soil the length of bridges by their own dead weight and the telephone system by the central telephone capacity It is very likely that man with the best developed mental and nervous system of all animals is facing one of those limitations of nature wherein the highly specialized organs like the brain may have reached a level of declining efficiency tending towards extinction Whatever be the prognosis this field of study into the realms of communication and control in both biology and engineering offer a very fertile and stimulating ground for research and investigation by engineers mathematicians and physiologists The science of cybernetics can best be described in the words of Sir D Arcy Thomson as a field which few have entered and no man explored —a field of study which will have a serious repercussion on the challenging forces of human civilisation by devaluating the human brain and rendering medicore hopo sapiens more parasites in this drifting world

REFERENCES

[1] J C Maxwell *Proc Roy Soc* (Lond) March 5 1868

[2] N Wiener Cybernetics Wiley N Y 1949
Also *Scientific American* Nov 1948 p 14

[3] D Arcy Thomson On Growth & Form First Edition 1918 Revised 2nd Ed 1945 Camb Univ Press
Laner Lesnick and Matson Servomechanism Fundamentals 1947 McGraw Hill N Y

[5] Dirk J Struik A Concise History of Mathematics 2 Vols 1948 Dover U S A

[6] J Crank The Differential Analyser Longmans 1947
V Bush *Jour Franklin Inst* *212* 447 1931

[7] *Bull Seis Soc of America* Jan 1949 p 47

[8] *Engineering* June 3 1949 p 526
A Svoboda Computing Mechanisms & Linkages 27 M I T Radiation Lab Series 1948 McGraw Hill N Y

A PRELIMINARY ACCOUNT OF A GEOGRAPHICAL EXPEDITION TO THE CENTRAL HIMALAYAS

H I CHIBBER

BANARAS HINDU UNIVERSITY BANARAS

THE author of this communication led an expedition during late September and the whole of October 1949 to the Central Himalayas and spent five weeks in exploring this region from Tehri to Gangotri a distance of more than 100 miles Valuable and interesting results have been obtained in the various aspects of geography and geology

The trend of the mountain ranges of the Middle and Great Himalayas of this part and the various land forms they build have been carefully studied along with the course of the Bhagirathi (as it is called locally) from where it takes its source to as far as Tehri This river has carved out many interesting flat terraces which are today very important from economic and human point of view In fact the Bhagirathi had developed a flat bed in these mountains several times but it was rejuvenated once more to commence vertical corrasion and now flows through such deep canyons that it is not visible in places while standing on the edge of these gorges This series of flat terraces with their alluvial soils have provided valuable agricultural lands which of course support a good part of the local population Consequent upon this rejuvenation the river has carved out beautiful incised meanders which are V shaped U shaped inverted U shaped etc Near Dharali about 13 miles from Gangotri glacial lakes occur which indicate the existence of glaciers in the post although they have disappeared now

The climate is again interesting although very trying In the lower valleys even in mid October the sun was almost scorching during midday but in the higher elevations the conditions were reversed almost freezing The geology and the structure are again full of interest and the area has been geologically mapped from Tehri to Gangotri Thermal springs near Gangnani which may be perhaps radioactive have also been studied

The soils derived from the decay of these rocks provide the terraced fields at different elevations the scope for cultivation and the crops grown vary with the altitude The plant and animal succession from Tehri a little over 2 000 ft to above Gangotri, at elevations of 10,000 ft. and more has been observed. It has been possible to do zoning in plant, animal, agricultural and human geography for the first time.

The various types of human settlements were also the subject of study and their location has been investigated. The elevations to which these permanent and seasonal settlements extend have also been recorded. There is an important Tibetan colony at Harsil about 15 miles below Gangotri and the people spend their summer there but migrate during winter to lower regions with their flocks of sheep and goats. These animals with some Tibetan ponies also provide the transport for their wool and salt which they bring from Tibet and barter for rice or sell in the Indian territory. Thus there is an important Indo-Tibetan trade which is carried on by these people called Jadhs. There is a woollen manufacturing industry at Harsil which is carried on during summer season. The high mountain pastures of this area at elevations of 12,000-14,000 ft. above the sea are again interesting where the mountain people take their cattle, goats and sheep for grazing in summer. With the advent of winter they migrate back to the lower regions even as far as to the Terai grasslands of Rishi Kesh.

It may be noted that Harsil and the neighbourhood comprise an apple, pear and walnut producing region and this is the only redeeming trait of this otherwise very inhospitable region where flour, apparently a mixture of various cereals, is sold at Rs 1/8 per seer. Some of these orchards were however washed away by inundation of the Jullundur stream few years ago. Both wheat and rice have to be imported above Bhatwari. Potatoes which represent the sole vegetable of the region are cheap from Suki to Dharali. The military geography of this frontier region has also been studied.

With regard to communications there is a bus service to Tehri which they propose to extend to Dharasu a distance of another 28 miles but at the time of the author's visit several of the bridges had been breached or had yet to be constructed. In places the path had been cut in hard rock with overhanging ledges and is very narrow indeed. But the most difficult part was where the path had been washed away by landslides. In such places the mules had to be passed over by supporting them from the front and the tail. In places this makes conditions very trying as the so called path, not even an apology for a footpath but much less for a mule track, overlooks the river several hundred feet but not infrequently a thousand feet below.

The last Post but not Telegraph Office is at Uttarkashi 56 miles from Gangotri. The Telegraph Office is at Tehri another 44 miles distant.

The expedition is a record for light travelling. The whole of the author's kit was carried by a single mule. He lived on the country where the local supplies excepting ata and potatoes are next to nothing. The entire time was spent in marching up and down without any break and sometimes a camp was reached at night where no food could be cooked for want of firewood.

It may also be noted that the author received no financial assistance from any quarter. It is indeed surprising that even with our Independence and our own Government trivial financial aid for such work is not forthcoming. Foreign countries including Switzerland have sent expeditions to the Himalayas but in their case full aid of the Government, the learned societies and the public including philanthropists was placed at their disposal.

There is a considerable pious wish for research work in the country but how could the pious wishes be carried out without the provision of even meagre or trifling financial help. It is familiar that professors especially those of India are never monied people and it is practically impossible to cope with the expenses of such journeys.

THE HYDROGEN BOMB

B. D. NAG & SANTIMAY CHATTERJEE

INSTITUTE OF NUCLEAR PHYSICS, CALCUTTA UNIVERSITY

THE recent announcement of the possibility of a bomb said to be many times more effective than the atom bomb using uranium (235) or plutonium (239) by the American press following shortly on an announcement that the Russians also possess the atom bomb has been received with mixed feelings. The ghastly prospect of an atomic armament race is now a reality. The developments of modern nuclear physics has been spectacular in the extreme and the tremendous amount of effort that has been going into nuclear physics has been yielding, rich though not always desirable, harvest. It behoves us to examine this latest development carefully to determine as far as present reports, and the past scientific literature on the subject permit the extent and the possibilities of the suggested methods of obtaining an extremely destructive explosive and its probable effects.

Historically speaking even before fission was discovered physicists and astrophysicists have speculated on the origin of the enormous energies of the stars through billions of years. No chemical energy can possibly give energies of the order that a star gives out for so many million years and that without apparent change in the stars mass or structure. With the discovery of various nuclear reactions and the observation that many of these reactions yield extremely large quantities of energy many million times more than chemical reactions, physicists started speculating on the possibility of nuclear reactions as the source of stellar energy These speculations proved extremely fruitful Gamow was able to show that at the calculated temperatures of the interior of the stars the thermal energy of the atoms constituting the stellar core were of such magnitude as to enable nuclear reactions of certain types to take place In fact Gamow was able to show that if the interior temperature of the sun was assumed to be somewhat greater than a million degrees centigrade, enough nuclear reactions of certain types could take place to explain the output of solar energy for billions of years The corresponding loss of the mass of the star as these nuclear reactions proceed, will be given by Einstein s relationship between mass and energy $E=mc^2$ The loss of mass during the whole life time of the star works out to be a few percents of the total mass of star This looks so reasonable that most physicists and astronomers accepted the idea that the origin of stellar energy is due to nuclear reactions taking place in the core of the star The fast particles necessary to produce nuclear reactions are produced by the high temperatures in the stellar interior, and the production of energy in turn helps to keep the stellar interior hot enough to produce further reactions The extraordinary success of this idea is due to the very exact calculation of temperatures possible by this theory and its extremely good agreement with the calculation of stellar interior temperatures from the mass luminosity and the surface temperature of the stars

Before going further into the condition of stellar interiors let us look into the fundamental structure of the nucleus consisting of a number of protons and neutrons which is denoted by $_ZM^A$, where A is the mass number, Z is the number of protons and (A–Z) the number of neutrons in the nucleus and M the mass of the nucleus Z is also the atomic number The masses of different nuclei are expressed with respect to oxygen (A–16 Z–8) mass, M=16 000,000 For any nucleus the mass is expected to be equal to the masses of the protons and neutrons But it is found to be always a bit less The reason is that during the formation of the nucleus some energy is evolved This binding energy E, as it is called, is given by the difference in mass expressed in energy so that if the nucleons or the nuclear particles have to be separated from one another the nucleus has got to be supplied with this binding energy The average binding energy per nucleon is $\frac{E}{A}$ and is generally expressed in electron volts (1 e v =1 589×10 ¹² ergs) The masses of most nuclei are very accurately known and the relation between the average binding energy $\frac{E}{A}$ and mass A can be seen from fig 1 (Evans) It will be interesting to notice that E/A is markedly smaller in lighter nuclei Hence if by nuclear transformation nuclei of lower A can be changed into nuclei of higher A, energy will be liberated. The marked variation of E/A in lighter nuclei also shows a prospect of possible source of nuclear energy by nuclear transformation Lastly the binding energy per nucleon difference between the heavy and medium weight neuclei is about 1 Mev per nucleon, showing an yield of about 200 Mev for uranium fission

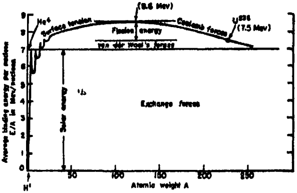


Fig 1

Thus the possible reactions for production of nuclear energy can be divided into four groups,

(A) Building up of nuclei from nucleons and energy release

$$2\,{}_1H^1+2\,{}_0n^1\rightarrow{}_2He^4+28\text{Mev [or 7 Mev/nucleon]}$$

(B) Exciting changes in lighter nuclei by nuclear transformation and release of energy

$${}_2He^3+{}_1H^1\rightarrow{}_2He^4+\beta^++25\text{ Mev [or 6 Mev/nucleon]}$$

$${}_3Li^7+{}_1H^1\rightarrow 2\,{}_2He^4+(1\text{ to }17)\text{Mev [or 2 Mev/nucleon]}$$

(C) Building up of nuclei of higher atomic number from light nuclei by nuclear transformation and release of energy—the carbon nitrogen cycle

(D) Fission of heavy nuclei into two or more medium weight nuclei and energy release

$${}_{92}U^{238}\rightarrow{}_{46}\times^{119}+{}_{46}\times^{118}+2n+200\text{ Mev [1 Mev/nucleon]}$$

Reaction A has not been considered practicable because it is a many body reaction The reactions 'B' and 'C' has been common after the invention of accelerators like the cyclotron Nuclei of different elements are bombarded by nucleons like the proton or deuterium or by the helium nuclei accelerated to several million electron volt energies But the total energy release in these cases are never very large as the densities of the bombarding ion beams are of the order of 10 ¹⁴ gm/cm³ for a beam current of 1 m A per cm² The method D is very effective in respect of producing energy The release per fission is of the order of 200 mev Moreover in neutron induced fission more neutrons come out as part of fission products which, under favourable condition, can again induce fission, thus giving rise to what is known as the chain reaction This fact has been utilised in the making of the atom bomb, the details of which have been discussed in many volumes The release of energy is very high In one gramme of uranium there are 2 5×20²¹ atoms and with 200 mev of energy associated per atom, the energy release will be 8×10¹⁷ ergs. per gramme or 2×10⁷ kilo calorie per gm To get this amount of energy, we have to burn nearly 2½ tons of coal.

The atom bomb, or rather, the fission bomb thus yields somewhat less than 1 mev per mass unit and is limited by the fact that the bomb explodes on reaching a critical size and it is not very practicable to use amounts of plutonium or actinouranium very much greater than the critical size, which may be estimated to be somewhere between 5 and 30 kgm with a diameter of about 14 cm The fact that there are other nuclear reactions which yield energies as great as or greater than 1 mev per unit mass and that materials of these reactions, hydrogen deuterium and lithium are fairly common and very much cheaper and easily available than plutonium or uranium 235 led to investigations relating to the possibility of using these reactions The fact that these reactions occur in stars, and in the laboratory has made it easy to determine under what condition these reactions could be made to occur in a large scale Let us examine the conditions under which these thermonuclear reactions occur in stars before we deal with conditions under which they may be made to occur here If we take the sun as a convenient example we notice that the sun has a surface temperature of about 6000°C, a surface density of about 10^{14} gm/c c and a surface pressure of about $\frac{1}{100}$ *atmospheric pressure* It may be deduced that the temperatures of the interior of the sun at ¼ R distance from centre and at the centre are given as shown in diagram 2 At these high temperatures the thermal velocities of the atoms may be calculated from classical kinetic theory of gases We give below the velocity distribution curve of Maxwell plotted for 10^8 K° with the velocities and energies in electron volt units of Hydrogen, Deuterium and Lithium Since the threshold of the D D reaction $D+D=He^3+n+14$Mev is at an energy of about 10 Kev, there will be an energy release of 3 2 mev per unit mass for about half the collisions, as about half (actually, somewhat more) the deuterium atoms have the requisite threshold energy of 10 Kev to cause an energy yielding nuclear reaction

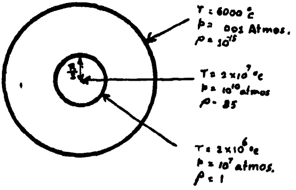


Fig 2

The actual energy yield per second, will be thus determined not only by the velocities but also from the chance of an energy producing collision This will depend on the number of atoms per unit volume, that is the pressure and on the ratio of the number of energy producing type of atoms to those that will not yield any energy on collision If however, we have, instead of deuterium, a mixture of hydrogen and lithium, their kinetic energy will be the same, but the threshold being at about 20 Kev, comparatively few energy yielding collisions will take place and a longer time will be needed to obtain the same number of energy yielding atomic collisions There will also be the additional factor of the decrease due to the fact that only Li—H collisions will yield energy and not Li—Li or H—H collisions

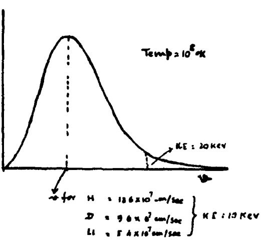


Fig 3

Moreover the density of the colliding nucleons will be of the order of density of the material in contrast to 10^{14} gm/cm³ density of the bombarding ion beams After the making of the atom bomb the raising of temperatures to the order of 10^8°C no longer remains a desperate gambling with digits Equating the kinetic energy $\left(\text{velocity} = \sqrt{\frac{3KT}{m}}\right)$ with the fission energy release the temperature can be calculated to be of the order of 10^8°C thus showing that the hydrogen bomb is not very far off The temperature of the whole mass calculated due to the liberation of fission energy will be initially 10^8 °C and will decrease rapidly from this initial value If the temperature remains high during the time necessary for a few collisions, a large fraction of the total deuterium will be converted into He^3+n by the reaction

$$D+D = He^3+n$$

In the gaseous mass the rate of collisions will be 10^{11} per second per deuterium atom assuming that in reaching the maximum temperature the gaseous mass has expanded between a hundred to a thousand fold The rate of energy production is enormously fast and half of the deuterium should be able to react in about 10^{10} seconds, yielding an energy of 1×10^{27} e v or 3 33 $\times 10^{15}$ ergs In more precise language, in thermonuclear reactions the bulk of the transformations is not due to the particles that possess the mean energy of thermal motion, but to much faster particles in the

Maxwell distribution for which increased penetration effectiveness over compensates the decrease in relative number In fig 4 (Gamow) the relative number of parti

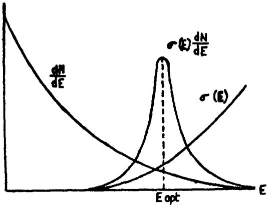


Fig 4

cles $\frac{dN}{dF}$ and their reaction cross section σ are plotted as function of energy F The total number of disintegration for any energy given by $\sigma(E)\frac{dN}{dE}$ can be seen to have a maximum at an optimum energy which again corresponds to some particular temperature The reaction rate can be estimated by integrating σ (E) $\frac{dN}{dE}$ from 0 to ∞ The relation between temperature T and the energy release for the reaction $H^2+H^2 \rightarrow He^3+n$ is shown in fig 5 (Gamow) It will be seen that up to

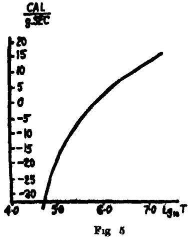


Fig 5

T = 10^5 the thermonuclear energy release is of the order of 10^{-7} Cal/g sec At T = 10^6°C it is 300, at T = 3×10^6 °C it is 3×10^7 and at T = 10^7 °C it is 3×10^{13} cal/g sec, at T = 10^8°C it is of the order already estimated above

These are of course highly idealised conditions, but we may now examine the possible thermonuclear reactions that will yield high energies at temperatures that may be obtained in the explosion of fission type bomb These reactions are shown below with the threshold energies the equivalent temperature for thermonuclear reaction, energy liberated, mean reaction time and rate of energy production This is by no means a complete list of thermonuclear reactions as some of the most important ones in astrophysics have been omitted from this list purposely The Carbon Cycle which is the set of thermonuclear reactions supposedly occurring in all the main sequence stars converting carbon and hydrogen to nitrogen and oxygen is purposely omitted as they are reactions that have slow rates and are essentially important in reactions occurring at a temperature equilibrium

The temperatures do not signify the minimum at which the reaction will proceed but a temperature near the region where a large fraction of the particles will have velocity greater than the threshold energy of the reaction Thus the reaction can proceed at much lower temperature Once the reaction has started the energy evolved will increase the temperature which again will accelerate the reaction and the process will go on till the whole of the matter has reacted This is not unlike a chain reaction although it is not a chain reaction as it is usually understood The rate of energy production will depend on the number of nuclear collisions which again depends on temperature as well as on pressure i e the number of nuclei per unit volume and on the type of reaction For example in the case of D—D reaction one can imagine a homogeneous deuterium gas where every collision will be between two deuterium atoms and with proper temperature almost all of the total energy release may be obtained in the time of the order taken by a single collision In such cases almost all the energy of the reaction is obtainable almost instantaneously In a $Li^7—H^1$ reaction the changes of energy yielding reaction s diminished by the factor that $Li^7—Li^7$ and $H^1—H^1$ collisions will not yield energy and thus the Li—H reaction will not yeild energy as rapidly even under equally favourable circumstances

Reactions	Threshold energy in k e v	Equivalent temperature in c	Q in ergs	Reaction time in sec at 10^8 °c	Rate of energy production in kilocalories per gm sec
$D+H \rightarrow He^3+\gamma$	9	$7\ 1\times10^7$	$8\ 8\times10^{-6}$	10^{14}	$9\ 5\times10^8$
$H^3+H \rightarrow He^4+\gamma$	10	9×10^7	$39\ 9\times10^{-6}$	10^{0}	$2\ 1\times10$
$D+D \rightarrow He^3+n$	8	$6\ 3\times10^7$	$4\ 1\times10^{-6}$	10^{1}	$2\ 3\times10^7$
$Li^7+H \rightarrow 2He$	12	$9\ 3\times10$	$27\ 7\times10^{-6}$	10^{5}	3×10
$Be^9+H \rightarrow Li^6+He$	18	$1\ 4\times10^8$	$3\ 6\times10^{-6}$	10^{-1}	$1\ 9\times10^5$

We thus see that apart from the D—D reaction, D—H H^3—H and Li—H are the three most likley reaction to be effective in yielding a large portion of the total energy in a very short time From the point of view of constructional convenience hydrogen, deuterium and helium (3) suffer from some serious defects. They are gases and cannot be packed in the small volume of a bomb without some serious difficulties Lithium is a solid metal and the hydride of lithium LiH is well known as a fairly stable solid which may be packed in the small volume of a bomb with convenience The choice of a liquid or solid as the initial starting substance is necessitated by the additional reason of extremely rapid transfer of heat to the packing substance without loss of matter by expansion of the gases too rapidly, which may decrease the effectiveness of the bomb It is important to have the thermonuclear reaction go as rapid as possible, also for the reason that the energy liberated should counter balance the losses due to radiation and rapid expansion of the hot gases to enable utilization of a large part of the nuclear energy of the packing substance All this information is well known to astrophysicists since Bethe Weizsäcker and Gamow have correlated the energy given out by stars to the interior temperatures of stars and the thermonuclear reactions that may take place in the interior due to the high speed atoms

The question now arises as to the possibility of obtaining rapid rate of thermonuclear reactions with the means now at hand The atom bomb of plutonium or actinouranium fission causes an extremely high temperature and we can try to estimate the temperature we may so obtain For purposes of a rough calculation we may take 10 kgm of Plutonium and estimating that at least 50% of it yields energy by fission, we have a total energy yield of $2\ 4 \times 10^{21}$ ergs Let us suppose now that the atom bomb has in it about an equal weight of other materials and 10 times its weight of deuterium On explosion the energy is first dissipated into this 120 kgm of matter and thence to the surrounding medium A certain amount of the energy is lost due to immediate radiation which we may take roughly into account from the known radiations accompanying fission and estimate such losses at about one fourth of the total energy The balance may be presumed to heat up the mass of matter Because of the large quantities of heat and high temperature involved the fraction of heat going to the latent heats of liquifaction and evaporation may be neglected Assuming the rise of pressure to about 10^6 atmosphere the temperature calculated comes out to be 100 million degrees centrigade This is of course exteremely rough but the rise of pressure is taken from known discussions on the atom bomb explosions (vide Stephen's Nuclear Fission and Atomic Energy) It is evident however that the spectroscopic data on the atom bomb explosions obtained by U S and Russian scientists enable them to obtain actual values of the temperature from such observations Assuming that the temperature is 10^8°C, the D D reaction is the only important reaction liberating energy, and an efficiency of 10%, the liberated energy of the hydrogen bomb is about 300 times that of the atom bomb There are however many assumptions made in such a rough calculation the important ones are, the actual temperature and the pressure of the exploding gases which must be well known to those concerned It is however quite justifiable to assume that the total energy yeild in such bombs as we have discussed may be easily between hundred to a thousand times greater than that of an atom bomb and the total energy yield may be kept down to any desired figure by giving suitable quantities of the packing material However, since these thermonuclear reactions are not chain reactions there is little chance that such reactions will ever yield controllable useful power as fission has been used in a pile Thus the development of the hydrogen bomb may be considered to be a completely destructive weapon which has no other possible use except perhaps as a scientific curiosity There is another point that is very often brought up Is it possible that a hydrogen bomb exploded may cause the whole earth to be destroyed? It is not an easy question to answer A fairly accurate answer to the question may be that with a single hydrogen bomb of normally expected size, not enough energy is generated to start wholesale disaster, nor it is possible to start a progressive thermonuclear reaction as the quantities of lithium and deuterium are very limited on the earth's surface What will happen if a large number of such bombs are purposely used to destroy the world is a question that needs no answer

Notes and News

UNIFIED FIELD THEORY

Albert Einstein has been engaged for the last 33 years, since he announced his general theory of relativity in 1916, in an effort to develop a "unified field theory". The problem is to relate the physical phenomena in the submicroscopic world of the atom to those in the macroscopic world of universal space-time, to find a common principle explaining both electromagnetic forces and gravitational force, or what relativists now call space time curvature In this inquiry Einstein has pursued a lonely course, most physicists have taken the apparently more promising road of quantum theory Again and again in the past two decades Einstein and his few companions in the quest for a unified field theory have discovered what seemed to be hopeful avenues to a solution, only to be stopped by insurmountable flaws in their reasoning.

Einstein believes that he has finally achieved a solution, or at least the most successful solution so far In a new edition of his famous work *The Meaning of Relativity*, to be shortly published by the Princeton University Press, Einstein will set forth what some of his friends say is the long sought unified field theory The scientist himself has given no public hint of any such extraordinary development, but he is said to have told close associates at the Institute for Advanced Study that he regards the new theory as his greatest achievement

Einstein's paper explaining this new work will appear as a modest 16 page appendix to his republished book If it is indeed a statement of a unified field theory, and if it can be confirmed by other workers, it will be the most important event in theoretical physics in many years

GERMANIUM HELIUM ALLOYS

Germanium helium alloys suitable for making high grade rectifiers, also methods of making the alloys, are covered by a recent patent

The germanium helium alloys are not alloys as the term is generally used, for in this invention germanium metal is impregnated with helium gas The combination exhibits electrical properties such as are found in metals and in what is known as semi conductors The impregnation may be accomplished by melting pure germanium and heating to about 1050°C in a boat of crucible placed in a suitable furnace The molten metal is maintained in an atmosphere of helium in the furnace from five to fifteen minutes After the germanium and helium are mixed, the melt is allowed to cool, and then cut into wafers, ground and etched It is ready then to be embodied as the semi conductor in a contact type rectifier

Electrical semi conductors containing germanium have been produced which promise to have varied applications in the fields of radio, radar, and microwaves (*Journal of Chemical Education*, January 1950)

GERMICIDE EVALUATION

A new method for evaluating germicides, such as iodine, merthiolate, mercurochrome, and the new antibiotics, has been developed at the University of California, Los Angeles

The new technique known as the toxicity method for the evaluation of germicides, is concerned with the effect of the germicide on the growth of tissue from chick hearts of 13 day old embryos as well as on bacteria Effect of the germicide on the tissue after a 10 minute exposure as compared with its effect on bacteria under the same conditions is used to establish a toxicity index The index is the ratio of the highest dilution of germicide required to kill the chick tissue in 10 minutes to the highest dilution required to kill the bacteria test organism during the same period and under identical circumstances This method aims to measure the relative efficiency of germicide which are to be used for the destruction of bacteria in living tissue The 10 minute exposure period is probably the maximun time for effective germicidal action on a cut surface or mucous membrane (*Chemical and Engineering News*, December 26 1949)

NEW VITAMIN A ASSAY

Although a spectrophotometric procedure constituting the vitamin A assay is known and used for some time, a method has recently been devised for improving its specificity as a measure of vitamin A by eliminating the interference of substances which absorb light in the same ultraviolet range

The method has been applied in two steps The distortion of the adsorption curve is first corrected from the true vitamin A curve such as may be caused by oxidation products and other non vitamin A substances As a second step correction has been made for the displacement in height of the curve caused by such irrelevant absorption

The method of applying the above corrections has also been simplified by combining the slope and height corrections into a single equation from which a monogram is prepared This permits direct reading of the correction factor The new assay soon to be adopted and made official in the U S Pharmacopoeia XIV will gain in specificity by correlation with the well known colorimetric (antimony trichloride) test In effect the new assay will reduce the numerical rating of vitamin A content of most fish liver oils as compared with values previously obtained The extent of this decrease will be in the neighbourhood of 10% (*Chemical and Engineering News*, December 19, 1949)

RADIOACTIVE TRACERS IN PLATING PROCESS

A better understanding of the mechanism of electro deposition in chrome plating has resulted from recent studies at the National Bureau of Standards, Washington, D C, using radioactive tracer techniques By tagging either the trivalent or the hexavalent chromium ion in a chromic acid plating bath with radioactive chromium 51, it was conclusively shown that metallic chromium is deposited out of the bath from the hexavalent state rather than from the trivalent state, as had previously been suggested

Chromium 51 is a soft gamma ray emitter with a half life of about 26 days Its radioactivity in the solutions and deposits was measured by a thin walled glass gamma ray counter connected to a scaler Isotopic exchange frequently takes place between different valence states of a metal Had it occurred in the bureau's investigation to any appreciable extent, it would have resulted in the presence of sizable quantities of both active trivalent and active hexavalent chromium in the plating bath This would have made it impossible to draw valid conclusions from the experiment It was necessary first to determine the extent to which isotopic exchange takes place between trivalent chromium and chromic acid in the plating bath

A stock solution containing both trivalent and hexavalent inactive chromium ions in fixed proportions was divided into two parts To one part, active hexavalent chromium was added as chromic acid, to the other, active trivalent chromium was added as chromium chloride These solutions were kept at 50°C for one hour and at intervals 5 ml samples were taken from each solution The hexavalent and trivalent chromium in each sample were separated chemically, and the activity of each fraction was measured The activities of the two fractions of each sample showed that at the end of an hour a small portion of the tracer had undergone an isotopic exchange, but not enough to interfere with the investigation (*Chemical and Engineering News* December, 26, 1949)

ULTRASONICS IN INDUSTRY

A new low frequency magnetostriction generator which would be of much use in chemical and metallurgical operations has been developed at the Mullard Electronic Products Ltd

Generator is proving its value in ultrasonics research, especially in the treatment of extremely fine particles and bacteria, but the limitation of its power to 500W precludes its successful use in production processes The new magnetostriction generator overcomes this difficulty

The low frequency ultrasonic generator consists of a main unit (a driving oscillator, power amplifier and low voltage d c power supply, with monitoring and check meters) and the transducer unit (a stock of nickel laminations wound with a common coil for excitation and polarisation) The amplifier which provides the source of power for the transducer, delivers a maximum output of 1KW over a frequency range of 10 kc to 25 kc

The industrial suitability of the equipment depends on the design of the magnetostriction transducer The insulation of this is such that the whole unit may be immersed in conductive liquids without fear of damage or electrical shock With simple cooling arrangements a loading of about 5 W per sq cm can normally be used The three equipments available now are 1KW, weight 448 lb, 500W, weight 432 lb, and 250W, weight 364 lb All are 69 in high by 20½ in wide by 23 in deep The new equipment offers scope for work in the metallurgical field in the mixing of powdered and molten metals in alloy production It may also be used for speeding up the process of solidification in molten tin and aluminium and for the tinning of aluminium and similar metals Emulsification of a number of liquids, and the precipitation or dispersion of particles in suspension are further possibilities of ultrasonics (*The Chemical Age*, January 7, 1950)

ADVANTAGES OF JET AIRCRAFT

Speaking at a meeting under the joint auspices of the Aeronautical Society of India and the Council of Post-Graduate Teaching in Science, Calcutta University, Sir Frank Whittle, creator of the first gas turbine jet propulsion unit and adviser on jet development to BOAC, said that the chief thing that an aeroplane as a means of transport had to offer was speed

"The jet aeroplane makes possible speeds between 60 and 100% greater than with piston engined aircraft But speed is not the only advantage The passenger can rely on increased comfort chiefly because of reduced noise and vibration and also because the greater part of the flight will be at heights far above 'bumpy' conditions"

The jet plane also offered increased safety because of simpler engine controls and because absence of vibration reduced crew fatigue and improved radio communications The risk of the aircraft bursting into flames in the event of a minor crash was also negligible because the fuel used—aviation kerosene—was safer than petrol

The jet air liner, Sir Frank said was also more economical to operate and according to estimates the Comet, which has about the same take off weight and carries about the same payload as the Constellation, is 20% cheaper in operating costs per capacity ton mile Experience in the RAF indicated that the maintenance personnel required for jet engines was less than half of that required for piston engines The maintenance of the airframe was also likely to be greatly reduced because very large proportion of defects in conventional types was caused by engine vibration

For short range operation a very strong case could be made for jet aeroplanes Though for distances of about 200 miles the height at which the plane would be such that more fuel would be required than for piston engined aircraft, the low engine weight would more than compensate for this because the increased pay load, coupled with high speed, would mean increased revenue earning capacity

"The first jet airliners ' he added, will come into regular use within the next two years when BOAC begin to operate the Comet I believe that other airlines will be forced to follow suit rapidly Improvements in meteorological services, landing aids, radio communications, airport runways and traffic control methods will all tend to increase the advantages of the jet aeroplane over the piston-engined plane Moreover there are likely to be substantial reductions in aircraft drag and improvements in engine performance which will contribute to raising the cruising speed well over the present 490 mph of the Comet"

Sri C C Biswas, Vice-Chancellor of Calcutta University, presided at the lecture Rai Bahadur N C Ghosh who welcomed Sir Frank on behalf of the Aeronautical Society of India, said he was happy to state that the jet pioneer had agreed to become an *Honorary Fellow* of the Society

PEDIATRIC CONFERENCE

About 25% of the total deaths in India occurred among children between one and five years of age and most of the child mortality was from preventible diseases said Dr B C Roy, Chief Minister, West Bengal, opening the first annual conference of the Indian Pediatric Society at Medical College, Calcutta, on February 6 last

Delegates from Ceylon and various parts of India attended

Dr Roy added that pediatrics, or the medical science which relates to children and their special diseases, had not received the attention it deserved from the medical profession in this country This was because of the difficulty of diagnosis among children and the lack of training among women in bringing them up in the right way

His government, Dr Roy said, had spent about Rs 7 crores out of a total expenditure of Rs 32 crores on health, education and other social services this year An equal amount would be provided in the coming year's budget for social services This however was inadequate for the actual need of the country

Dr K C Chaudhuri, President, regretted the lack of facilities for child care in India There were, he said, only two children's hospitals in the country—Chittaranjan *Sishu Sadan* in Calcutta and Wadia Children's Hospital in Bombay, both founded by private endowments

There were hardly any places where pediatric nurses kindergarten teachers or dieticians could be given practical training There were not even 100 trained pediatricians in the country

About 40% of the population of India, forming a total of 135m, were children under 15 years of age Out of this, 10m were infants under one year, 42m between one and five years and 83m between five and 15 years For these 135m children 30 pediatricians, 250,000 nurses and an equal number of teachers, 25,000 health visitors and other personnel were required

According to the Bhore Committee report, this target would be reached in 1971 But though five years had passed since the Committee's report was published, they had not yet started the training of personnel

SIBPUR ENGINEERING COLLEGE

An assurance that the Sibpur Engineering College will be expanded and more accommodation and training facilities given to students was given by Dr B C Roy, Chief Minister, West Bengal, while he laid the foundation stone of a new college building on February 4 last

The Government of India, he said, was unable to give development grant but, he was sure that it would be possible for them to implement technological and engineering projects as these were closely associated with the development of the country as a whole People had now come to realise that without engineering training, no progress was possible

The West Bengal Government had already accepted the 1945-46 plan for the development of the Engineering College, but those who were to be taught must devote themselves to studies If India was to prosper, young men, wherever, they were placed, must take their avocations seriously as the future of the country ultimately depended on them

Rai Harendra Nath Chaudhuri, Education Minister, said that, because of financial stringency, the development of the College might take a little longer time than it was desired They had given Rs 20,000,00 to the College during 1949 50 and he believed that the programme of construction would not be slowed down in the next financial year

Sri N K Mitra, Chairman of the Governing Body of the College, said that the plan to increase the total number of students to be admitted each year from 300 to 1,200 was fast nearing completion and he hoped that the West Bengal Government would do everything to see that the development plan was implemented according to schedule

The Bengal Engineering College of Sibpur is one of six or seven institutions of its kind in India and caters for the needs of not only the people of West Bengal, but, to some extent, of Assam Orissa, Sikkim, Nepal etc Besides degree courses in civil mechanical electrical and metallurgical engineering, it has arranged from the current year to offer the All India Diploma Course in Architecture and the University Diploma for post graduate studies in town and regional planning

New buildings are being constructed in stages Construction of the college building commenced in December last year It is expected that in about three years the entire construction programme would be completed It is proposed to put up six new hostels to accommodate the increasing number of students Plans for hostel building are ready and is hoped that construction of at least one hostel would be completed this year

PROSPECTING FOR OIL IN PAKISTAN AND INDIA

The Burmah Oil Company's Lakhra test well encountered large volumes of water with a certain saline content under extreme pressure, at a depth of 12,666 ft on Jan 28 last The temperature of this water is just below boiling point At the producing horizon the pressure exceeds 12,000 pounds per square inch and even at the surface is such that the flow is largely atomized

There is not the slightest indication of any oil or gas associated with this water

Unfortunately, circumstances have been such as to make it impossible to tell so far what change of rock formation has been responsible for this development

The Burmah Oil Company (Pakistan Concessions) Limited began drilling operations at the Lakhra test well in Sind desert on May 24, 1948 The test well reached and passed a depth of 12,000 ft on Jan. 7, 1950, thus becoming one of the deepest test well in Asia (See *Science and Culture* *14* 380 1949)

The Geological Survey of India is at present investigating the possibility of striking oil bearing areas in Kangra district in the Punjab (?) in Saurashtra and in Assam The Burmah Oil Company (India Concessions) Ltd are prospecting in Assam and Tripura and the Standard Oil Company are making preliminary survey of various areas to decide if detailed geological work is justified

DISEASE RESISTANCE TOBACCO

The U S Department of Agriculture has been successful in producing new hybrid tobacco plant that are highly resistant to major tobacco diseases by crossing cultivated forms of tobacco plants with wild species

The disease resistant cross breds were obtained when common tobacco varieties were used as the female parents and the wild forms which ordinarily show a high degree of disease resistance were used as the male parents The progeny of the cross bred proved to be both stable and fertile

Earlier attempts in incorporating disease resistant qualities of wild types into the cultivated varieties failed it is reported due to the use of wild tobacco as the female parent and the cultivated form as the male parent (*Ame Newsfile Agri Suppl* February 1 1950)

FERTILIZING MATERIALS IN JAPAN

Farm manures have always been of great importance in the fertilizer programme of the Japanese farmer Among the various farm manures used by Japanese farmers compost is the most important source of plant nutrients In 1946 it supplied 47% of the total nitrogen 66% of the total phosphoric acid and 64% of the total potash applied to the soils of Japan

Night soil ranks next to compost in the Japanese farm manuring programme In 1946 night soil supplied 16% of all nitrogen 8% of all the phosphorus and 10% of all the potassium consumed in Japanese farms

Five per cent of nitrogen, 3% of phosphorus and 6% of potassium consumed in 1946 were obtained from green manures Green manures rank third in importance among the farm manures used in Japan During the same year other farm manures such as plant ashes, sea weed and animal excrements supplied 14% of nitrogen 15% of the phosphorus and 16% of potassium

The common method for making compost is given in the paper Information on the handling of night soil, both storage and application is also given Survival periods and other information on various pathogenic organisms in stored and applied night soil is presented Data on the composition of composts night soil and other kinds of farm manures are included as well as recommended applications of night soil and compost for the important food crops grown in Japan

The effects of the atomic bombs on increased crop yields in Hiroshima and Nagasaki can be attributed to the beneficial effect of burned soil and especially to ash accumulated from organic matter and burnt buildings rather than to the effects of radio activity *per se* (*Agronomy Journal* *41* 275 1949)

JOURNAL OF THE BIOLOGICAL SOCIETY OF ASSAM

The publication of this *Journal* (*Vol 1* 1949) priced at Rs 2/ (per copy) after the foundation of the society only six months back is a welcome sign pointing towards the future development of Science and Scientific attitude in Assam Assam with its unexplored forest resources rich in flora and fauna would be greatly benefited through the vehicle of this *Journal* in popularizing and disseminating scientific knowledge and also in stimulating original research This has been amply justified by going through the contents which include some interesting articles written not only in English but half of the pages of the *Journal* is devoted to articles written in the language of the province for the benefit of local intelligentsia. This is a venture but as the question of language is still a great problem awaiting solution in free and united India, it is better to have two separate journals instead of a mixture of bilingual languages

The first article in the English half is on Food poisoning by Dr C M Palmer a scientist well known to many in Calcutta when he was in charge of the Friends Service Unit for India and Pakistan This is a very interesting article written in a popular manner wherein the author has given short accounts of the three types of Bacteria *viz* *Clostridium* *Salmonella* and *Staphylococcus* which are responsible for the common cases of food poisoning their methods of infection and prevention

In another article on Plant Quarantines , by Prabhakar Rao and B B Mundkur of the Directorate of Plant Protection Quarantine and Storage Government of India the authors define the term plant quarantine and also deal with the reasons for having the same A portion is devoted to Foreign Quarantines their development in the world and in India

The article on Tea Pathology in N E India by A C Tunstall of the Tocklai Experimental Station gives a short account of the general principles on which research work on tea parasites has been developed in North East India The important pests and blights on the tea plants are briefly described and their control measures suggested

The portion on Blister Blight (*Exobasidium vexans masosee*) is particularly interesting as it takes a heavy toll of the crop in India In North East India it is claimed that this vegetable parasite has been brought under control to a very great extent although in the Tea plantations in the South it is continuing to make its presence felt

With the progress of time we hope the journal will improve in its standard and will include some original well illustrated articles We congratulate the sponsors for their noble attempt Information regarding the *Journal* may be had from Prof H K Baruah *Editor* University Botany Laboratory Cotton College Gauhati

INTERNATIONAL SCIENTIFIC AND TECHNICAL CONFERENCE AND CONGRESSES

Date	Subject of Conference	Organising Body	Location
May (Undecided)	General Assembly of the French Chronometric Society	M R Baillaud Director Observatorie National de Besancon	Lyon
May 8	9th International Congress of Seed Testing Association		Washington
June (Undecided)	Commonwealth Plant Genetical Conference	Secretary Commonwealth Agricultural Bureaux	U K
June (Undecided)	Review Conference Commonwealth Agricultural Bureaux	Mr W K Black Ministry of Agriculture and Fisheries 1 4 Cambridge Terrace W C 1	U K
July (Undecided)	6th International Congress on Radiology	Dr Ralston Paterson Christie Hospital Wilmslow Road Withington Manchester 20	London or Cambridge
July 1 15	1st International Congress of Cardiology	Prof Laubry 39 Avenue Victor Hugo Paris	Paris
July 3 9	International Conference on Shale Oil and Cannel Coal	Institute of Petroleum 26 Portland Place W 1	Glasgow
July 3 8	Conference on Civil Engineering Problems in the Colonies	Secretary Institute of Civil Engineers Great George Street S W 1	London
July 10 15	4th Planary World Power Conference	General Secretary 4th World Power Conference 201 ° Grand Buildings Trafalgar Square W C 2	London
July 11 14	Conference on the properties of semiconducting Materials	International Union of Physics and Royal Society	Reading University
July 12 20	7th International Botanical Congress	International Union of Biological Sciences Secretary General Dr Ewert Aberg Uppsala7	Stockholm
July 24 Aug 1	4th International Congress of Soil Science	Netherlands Society of Soil Science Secretary of British Society of Soil Science Dr E W Russell Department of Agriculture Oxford University	Holland
July 25 28	International Anatomical Congress	Secretary Mr W Gerdt Department of Human Anatomy University Museum Oxford	Oxford
Aug 30 Sept 6	International Conference on Mathematics	American Mathematical Society 531 West 116th Street, New York City 27	Cambridge Mass. U S A
Sept (Undecided)	International Congress of Cell Biology		Yale U S.A
Undecided	British Association Annual Meeting	British Association for the Advancement of Science	Brimingham
"	General Assembly International Union of Biological Science	Secretary Prof P Vayssiere Musee d'historie naturelle Entomologie Colonale 57 Rue deé Buffon Paris 5e	Stockholm
	6th International Congress of History of Science	International Union of Historical Sciences	Netherlands
	11th International Limnological Congress		Belgium
"	5th International Congress of Microbiology International Union of Biological Sciences	Dr Saint John Brooks Institut d Hygiene Lausanne	Rio de Jeneiro
"	18th International Congress of Physiology	Secretary Prof Lundsgaard Copenhagen	Copenhagen

CULTURE COLLECTIONS OF MICRO ORGANISMS

Under the auspices of the Indian National Committee on Type Culture Collection of Micro organisms it is proposed to issue a Directory of the Culture Collections of Micro organisms maintained at various centres in India including those in possession of individual specialists In order to make this document authoritative comprehensive and complete the active co-operation of all microbiologists and others interested in type cultures of micro-organisms is earnestly requested

Microbiologists in India are invited to send the following information covering (1) the name of the institution (2) name of the investigator in charge (3) nature of the collection (4) objects of the collection (5) lines of research connected with the collection and (6) number of micro-organisms classified under (*a*) viruses (*b*) bacteria (*c*) yeasts (*d*) fungi (*e*) algae (*f*) protozoa and others before March 31 1950 to Dr M Sreenivasaya Convener Indian National Committee on Type Culture Collection of Micro organisms Section of Fermentation Technology Indian Institute of Science Bangalore

A NEW SYNTHESIS OF ESTRONE

Recently a new synthesis of estrone in its natural stereochemical configuration has been achieved in the laboratory of Dr William S Johnson of the University of Wisconsin Madison Wisc U S A Dr D K Banerjee Professor of Organic Chemistry College of Engineering and Technology Jadavpur collaborated with Dr Johnson on this scheme as Watumull Foundation Research Fellow The New method appears to be more promising than the previous synthesis of Dr Mischer of Ciba Laboratories Basel Switzerland for large scale preparation of the substance

ANNOUNCEMENT

The UNESCO has made a grant of $ 100 to the Botanical Society of Bengal in aid of the Society's forthcoming publication on the discussions at the symposium meeting on Food and People' held in December last (See *Science and Culture* 15 275, 1950)

ERRATA

In January 1950 issue on p 323, Column 2 line 13 *read* 1950 *for* 1949

On p 331 Column 2 line 12, *read* 15 *for* 151 On p xvi line 4 from below *read* Rs 150/ *for* Rs 15/

On p 325 Column 1 line 23 *read* *B* 31 120 1950 *for* (under publication)

LETTERS TO THE EDITOR

[The Editors are not responsible for the views expressed in the letters]

A NEW FORMULA FOR ESTIMATION OF LEAF AREA IN BARLEY

Recently Ashby[1] has pointed out that change in leaf shape is determined by differences in (*i*) cell division and growth, (*ii*) chemical and physical changes in leaf tissue, (*iii*) environmental effects and (*iv*) age and maturity of leaves It has also been suggested that leaf forms respond to balance of carbohydrate and mineral salts and nutrient level during growing season Length of the day is equally effective In wheat and sugarcane, leaf size and leaf area have been noted to change with the internal conditions of plant growth such as age and maturity of plants, tiller age and leaf development, on the one hand, and external conditions of nutrition provided to the crop on the other[7,8,9,10]

Whatever be the factors in the development of leaf surface, relation between total leaf surface exposed on the plant and other physiological and economic characters such as dry matter accumulation, carbohydrate metabolism, yield and quality of fruits is well recognised It has been suggested that leaf area expansion is a very reliable index of the response of growth factors in all nutritional investigations

Various devices have, therefore, been used for measuring expanding leaf surface in a growing plant Such methods include among others[2 11], tracing individual leaves and determining area by counting squares or by planimeter, preparing blue prints of leaves and determining the area by planimeter, use of sensitised photopapers, photoelectric devices of various types[3,5,11,12], use of certain leaf indices[4,6] and adoption of cardboards of different sizes to suit different types of leaves Their relative utility in various physiological studies has been stressed from time to time A simpler method for determination of leaf surface or leaf area in the barley plant by utilising some of the leaf indices and linear measurements for such determinations is indicated in this paper

In case of barley plant, leaf shape is invariably linear irrespective of the conditions of growth In such type leaves, variation in area largely depends upon the length and breadth of the blade This important relationship is utilised for evolving a formula for leaf area determinations How the two are inter related is evident from Fig I An individual leaf is split up into the two halves along the mid vein ((Fig 1b), the two halves are placed upside down and joined together to give to the leaf a shape more or less approaching that of a rectangle In such a case the area of an individual leaf (Fig 1a) should correspond to the area of the reoriented halves of the same leaf (Fig 1c) In the latter case, length of the leaf multiplied by the breadth in the middle of the leaf would give the nearest approximation to the area covered by the rectangle

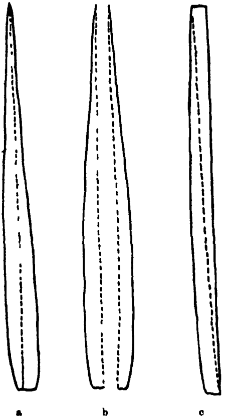


Fig 1 A single blade of Barley with leaf surface arranged in three positions

Determination of actual and calculated leaf area shows that area determined by length × breadth is invariably higher than the individual area of the thirty leaves sampled for this experiment Calculated area is found to be higher than the actual by 1 06–1 37 times in different cases This ratio between the calculated and the observed area approximates to an average of 1 20 for total population of thirty leaves This ratio is largely independent of size and dimensions of leaf age and development of foliage or tiller age It therefore provides an important physiological constant for determining the area exposed by a leaf on the growing plant

Data recorded in Table I show that $A - {}^{1}\,\frac{B}{K}$

where A = actual area L – length of individual leaf and B = breadth of the leaf in the middle and K – leaf factor 1 20

Expressed in another way in a more convenient form this relation may be indicated as follows

$$\text{Log}\,\Sigma A - \text{Log}\,\Sigma L + \text{Log}\,\Sigma B - \text{Log}\,K - \text{Log}\,N \quad (1)$$

where A L B and K stand for area length breadth and leaf factor respectively

The individual calculated areas of thirty leaves on summation approximates to the total area of these thirty leaves well within 2 7% limit and is therefore within the range of experimental error allowed for such biological measurements

If individual leaf area is not desired the original equation (1) may be slightly modified to directly give the total area of the leaves exposed on the plant as follows

$$\text{Log}\,\Sigma A = \text{Log}\,\Sigma L + \text{Log}\,\Sigma B - \text{Log}\,K - \text{Log}\,N \quad (2)$$

where Σ A = total area of one surface only Σ L = total length of all leaves Σ B – total breadth of all leaves in the middle of leaf blade and K and N are the leaf factor and number of leaves sampled respectively

Calculations made in this way (Table 1) show that the experimentally determined area is again well within less than three per cent of the actual area of the leaves

Equation 2 $\text{Log}\,\Sigma A \ \ (\text{Log}\,\Sigma L + \text{Log}\,\Sigma B) - (\text{Log}\,K + \text{Log}\,N)$ may therefore be profitably utilised for estimating leaf surface exposed on the plant All that is needed is to have certain linear measurements of length and breadth of all leaves on a plant as indicated in Table 1 One obvious advantage of this method of computing area is the rapidity with which leaf area could be estimated for physiological studies The formula does not assume any hypothetical value for the leaf factor K this factor is separately determined on the basis of linear measurements on a fairly large population of leaves As the value of this constant does not change appreciably with age of leaf or tillering, the formula could be successfully utilised for estimation of leaf area at different stages of growth The method does not involve removal of leaf nor is there any appreciable leaf injury during linear measurement

TABLE 1

LINEAR MEASUREMENTS AND LEAF AREA DETERMINATION IN BARLEY ALL IN CMS

Serial No	Observed area A	Length L	Breadth B	L × B	Leaf factor K	Calculated Area
1	27 86	27 6	1 2	33 1	1 18	25 11
2	25 28	24 5	1 3	31 8	1 25	27 13
3	25 09	29 1	1 1	32 01	1 27	27 27
4	23 54	22 5	1 2	27 0	1 14	23 0
5	21 7	21 6	1 1	23 7	1 09	20 24
6	19 09	21 5	1 2	25 8	1 35	21 98
7	19 6	23 7	1 0	23 7	1 15	20 18
8	19 54	18 5	1 0	22 2	1 13	18 91
9	18 96	19 2	1 1	21 12	1 11	17 99
10	17 47	20 1	1 2	24 12	1 37	20 53
11	16 7	21 0	1 0	21 0	1 25	17 88
12	15 41	17 0	1 1	18 7	1 21	15 92
13	15 09	19 0	1 0	19 0	1 25	16 18
14	14 06	17 6	1 0	17 6	1 25	14 99
15	13 73	17 1	1 0	17 1	1 24	14 56
16	13 28	20 3	0 8	16 24	1 221	14 16
17	12 9	14 3	1 1	15 73	1 21	13 4
18	11 86	15 1	1 0	15 1	1 27	12 6
19	10 64	11 7	1 1	12 87	1 21	10 96
20	10 02	14 8	0 85	12 58	1 2	10 72
21	10 25	14 2	0 8	11 36	1 13	9 68
22	9 23	12 1	0 9	10 89	1 17	9 27
23	9 03	11 2	1 0	11 2	1 24	9 54
24	8 9	13 1	0 8	10 48	1 18	8 93
25	8 38	12 5	0 9	11 2 t	1 30	9 58
26	8 25	9 4	1 0	9 4	1 13	8 0
27	7 48	10 2	0 8	8 16	1 09	6 95
28	6 96	9 2	0 8	7 36	1 06	6 27
29	6 83	10 0	0 9	9 0	1 01	7 65
30	5 67	8	0 8	7 12	1 35	6 06
Total	433 16	307 0	30 25	526 69	36 22	445 84*
Calculated area on the basis of equation(2)						428 4**

* 2 7% of observed   ** 2 2% of observed

Its practical applicability in physiological and nutritional studies would be elucidated in subsequent communications

K N LAL
M S SUBBA RAO

Plant Physiological Laboratory
College of Agriculture
Hindu University Banaras
15 4 1949

REFERENCES

[1] Ashby F *Endeavour* *8* 18 25 1949
[2] Darrow G M *Plant Physiol* *7*(4) 745 47 1932
[3] Frear D E H *Plant Physiol* *10*(3) 569 574 1935
[4] Gregory F G *Ann Bot* *35* 94 123 1921
[5] Hibbard R P Gregsby B H and W Keck *Michigan Acad Sci* *23* 141 47 1937 (1938)
[6] Hopkins J W *Canadian Journ Agri Res* Sec C Bot Sc *17*(9) 300 304 1939
Lal K N and Pathak H S *Jour Ind Bot Soc*, *27*(1), 1948
[8] ——— S A Malkani and H S Pathak *Proc Ind Acad. Sci* *24* 225 242 1946
[9] ——— and G Prasad *Proc Nat Acad Sci* 1948. (Accepted)
[10] ——— and S Srivastva *Proc Ind Acad Sci* B, *29*(3), 1949
[11] Marshall R E *Journ Agric Res* *47*(6) 437–39, 1933
[12] Potter, G F *Proc Amer Soc Hort Sci*, *35*, 260-63, (1937), 1938
[13] Withrow R B *Jour Agri Res*, *46*(7), 637 43, 1933

PLEOCHROIC HALOES IN INDIAN MINERALS

Joly[9] established beyond doubt the radioactive origin of pleochroic haloes The occurrence of concentric rings were explained by him as the result of the effect of ionization of the medium by the alpha particles of varying ranges emanated by the successive products of radioactive disintegration The remarkably sharp boundaries of these rings were shown by him to correspond to the effect of maximum ionization which takes place at the extreme range of an alpha particle and which in the case of air had been practically demonstrated by Bragg and Kleeman The occurrence of "bleaching", "over exposure", and similar phenomenon observed in pleochroic haloes were compared by him to ordinary photographic effects or solarisation"

The exact stages in the progress of development of pleochroic haloes have not been adequately deciphered. Kerr-Lawson[12],[13] came to conclusions which were different and in part contradictory to those of Joly. Other anomalies have been observed in pleochroic haloes, such as the occurrences of haloes with diameters far greater or smaller than those comparable to known theoretical ranges of alpha particles, the so called embryonic haloes, etc All these have not been fully explained so far

Joly and Rutherford[11] attempted at an estimate of the geological age of pleochroic haloes By comparison of the intensity of colouration due to the halo nucleus with that due to the action of known quantity of radioactive preparation during a definite interval, and by estimating the radioactive content of the nucleus, they were able to arrive at estimates of the geological age. In doing this, they made a number of assumptions such as, that the nucleus is of zircon containing roughly 10% of U_3O_8, and so on, which are not quite justified From a recent study of the mineralogy of the minor accessory constituents of some granitic rocks in New-Zealand, Hutton[6] has shown that monazite, xenotime, and occasionally apatite form the nuclei of pleochroic haloes in biotite, but never zircon although this mineral may be present in the mica

Joly[10] from a study of pleochroic haloes of various geological ages came to the conclusion that the radii of the older haloes are slightly longer than those of the newer ones. Holmes[5] has shown that the discrepancy in the lengths of the radii are partly due to the non recognition of the existence of the actinium series, partly to erroneous measurements and partly due to mineral structure Knopf[15] concludes that haloes cannot be used to determine the age of minerals

The method usually adopted in the study of pleochroic haloes is "visual and subjective" A micrometer is used to measure the radii of the rings and from a visual estimation of their density and structure the sequence of halo development is followed Kerr Lawson[13] took photomicrographs and measured the density variations with a recording photometer. In this method, the record of the blackening in the halo would be distorted unless the calibration curve of the photographic plate be considered and flaws occurring in the plate would produce additional distortion. To overcome all these, Henderson and Bateson[4] used a photo electric cell and recorded the variation in intensity as curves on a sensisitive paper From their quantitative study, they believe that it is possible to utilize pleochroic haloes in the determination of geological time

The effect of heat on pleochroic haloes has not been definitely established. Poole[18] reported that the halo completely dissappears on heating Jedrzejowski[8] at about the same time claimed to have produced "bleaching" as a result of heating The problem seems to warrant further investigations

Pleochroic haloes have been reported to occur in various minerals in India Fermor[3] has described the occurrence of haloes around sphene in the actinolite schists of Gangpur state Dunn[2] has observed excellent haloes in the cordierite from Mogok Iyer[7a] has made measurements on a halo in biotite in the granites of the Chota Nagpur area, and has compared them with the radii of the haloes of corresponding age cited by Joly

Joly while working on the pleochroic haloes developed in biotite remarked that haloes developed in andalusite or cordierite do not appear to be susceptible for study as they are hazy and not clearly measurable Mahadevan[16] working on the haloes in cordierite occurring in cordierite-gneiss from Madura district, found among the haloes in cordierite all the features which Joly has described for those in biotite The haloes were found to be of all grades of development Besides this, dwarf and emanation haloes were also found Such dwarf haloes had been reported by Iimori and Yoshimura[7]. The great sensitiveness of cordierite to alpha rays and the absence of strong body colour in the mineral in thin sections, favour the observation and recording of delicate structures, such as the rings due to the extraordinarily long range alpha particles of the Uranium and Thorium series Krishnan and Mahadevan[14] have recorded the measurements of such "giant" pleochroic haloes in cordierite, and these have been explained as due to the alpha particles from ThC′ and RaC′ While describing the new type of pyroxene from Bidalote, Rama Rao and Rama Rao[19] found conspicuous and beautiful pleochroic haloes in Bidalotite Sri Rama Rao[20] has reported the occurrence of haloes in the biotites of the gneisses of the Bezwada area Mahadevan and Sastry[17] have reported their occurrences in the cordierite from the Vizag district Fermor[3] has suggested that the study of pleochroic haloes would be of help in the problem of the correlation of the ancient schistose formations

A number of sections containing pleochroic haloes in Indian Minerals have been observed by the author Haloes have been noticed conspicuously in biotite, hypersthene, hornblende, cordierite, and bidalotite besides others. Attempts have been made to improve the technique of measurements of the radii in these haloes In essence, the method was that described by Joly, and later by Mahadevan. A particular section of a cordierite-gneiss from the Bidalote area in Mysore, kindly supplied by Mr B Rama Rao, was carefully observed, and camera lucida drawings of every part of it was made noting down particularly the occurrence and positions of the pleochroic haloes It is rather interesting to note that single section with a total area of less than a square centimeter, contains no less than 700 pleochroic haloes, most of them developed in cordierite around inclusions which are colourless, and with a high refractive index, and which were presumed to be zircon Out of these about 60 to 70 are well developed, and they exhibit the characteristic concentric structure Measurements made on a few out of these showed that the halo radii coincided with calculated ranges of alpha particles of the Uranium or Thorium series in cordierite

A very large number of haloes were also noticed in the mineral bidalotite Particularly one of them was showing the structure very well developed In this, no less than five concentric rings have been identified The measurements of the radii of these rings were carefully made with a Leitz micrometer ocular under a magnification of nearly 200 diameters The ranges of the alpha particles of the Thorium and Uranium series were calculated from the published values of the chemical analysis, and density of the mineral The measured values for the five concentric rings are found to be very nearly the same as the calculated values Further investigations are being carried out on these haloes, and full details will be published elsewhere

Lastly, I wish to thank Prof C Mahadevan for suggesting this problem, and for his guidance and keen interest in the work

M S Doraiswami

Department of Geology,
Andhra University,
Waltair, 25-8 1949

References

[1] Dunn J.A *Rec G.S I*, *65*, 448, 1931
[2] Fermor, L L *Rec G S I*, *65*, 74, 1931
[3] Fermor, L L *Mem G.S I*, *70*, Pt 1 1935
[4] Henderson G H & Bateson, S *Proc Roy Soc*, *London*, *A145*, 563
[5] Holmes, A Physics of the Earth Series, *4*, 159 196, 1931
[6] Hutton, C O *Amer Jour Sci*, *245*, No 3, 154 57, 1947
[7] Iimori, S Yoshimura J Sc Pap Inst Phys and Chem Research, *5*, No 66, 11 24, Tokyo, 1926
[7a] Iyer, L. A N *Rec G S I*, *65*, 500, 1931
[8] Jedrzejowsk, H *Compt Rend*, *186*, 135 137, 1928
[9] Joly, J *Phil Mag*, *13*, 381 383, 1907
[10] Joly, J. *Proc Roy Soc*, London, *A102*, 682, 1923
[11] Joly, J & Rutherford E *Phil. Mag*, *25* 644 657, 1913
[12] Kerr Lawson, D E Univ Toronto Studies, *Geol Ser*, *24*, 54 71, 1927
[13] ——————————*27*, 15 27, 1938
[14] Krishnan, M S & Mahadevan, C *Ind Jour Physics* *5*, 669, 1930
[15] Knopf, A Physics of the Earth, *4*, 8, 1931
[16] Mahadevan, C *Ind Jour Physics*, *1*, 445, 1927
[17] Poole, J H J *Phil Mag*, *5*, 132 141, 1928.
[18] Rama Rao, B & Rama Rao, L *Proc Ind Acad Sci* *5*, B, 190 195, 1937
[19] Sr Rama Rao, M *Proc Ind Acad Sci*, *24A*, p 199, 1946
[20] Mahadevan, C & Sastry, G G K *Proc Ind. Acad. Sci*, *27A*, 361, 1948.

VEIN SPLITTING, A BORON DEFICIENCY DISEASE OF CITRUS IN ASSAM

In the collection block of the Citrus Fruit Research Station, Burnihat two species of citrus, namely *Karun Jamir* or *Tita Karuna* (*Citrus aurantium* Linn) and *Robab Tenga* (*C grandis* Osbek) showed a peculiar condition after five years' of orchard life *Karun Jamir*, however, was more severely affected than *Robab Tenga* Seven other species of citrus growing side by side in the same block under the same soil and climatic conditions are however, free from this trouble These species are—*Khasi* orange (*C reticulata* Blanco), *Jora Tenga* (*C medica* Linn), Assam lemon (*C limon* Burm), *Satkora* (*C macroptera* Mont), *Soh Myndong* (*C Jambhiri* Lush), *Soh Sarkar* (*C Karna* Raf) and *Karimganj* lime (*C aurantifolia* Swingle)

The most characteristic and pronounced symptoms are an enlargement, corking and splitting of the midrib and the veins of the leaf The leaves tend to curl downward towards the midrib and take on a lusterless, slightly yellowish, brown or bronzed appearance The surface of the leaves also become corky and brittle Typical corking and splitting of the veins of the leaf is shown in Fig 1

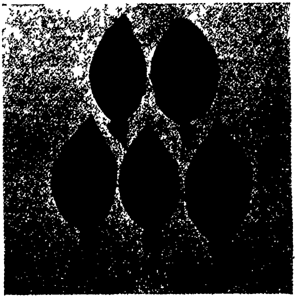


Fig 1 Corking and Vein splitting of *Citrus grandis*

Haas[1] and Haas and Klotz[2],[3] reported splitting and corking of veins of citrus leaves in culture due to boron deficiency Morris[4] reported that a condition of citrus termed "hard fruit" under field conditions in Rhodesia can be corrected by soil application of boron. The fruits borne on such trees are hard, often misshapen and undersized, with gumspots appearing in both the flesh and the albedo No corking and splitting of the veins, however, were noticed by Morris. The present investigators also failed to notice any "hard fruit" splitting of the veins at Burnihat. Chapman, Leibig and Vanselow[5] on the contrary found that the vein splitting symptom in citrus leaves could also be brought on by prolonged iron deficiency nitrogen deficiency potassium excess or potassium deficiency even though the nutrient solution supplied to such plants contained ample boron for normal plants

So far these troubles have not been noticed in any other part of Assam or reported from elsewhere in India This is also probably the first report about the occurrence of such symptoms in citrus under field conditions

A preliminary trial was conducted at the Citrus Fruit Research Station Burnihat with a view to see whether the troubles noticed could be corrected by an application of boron to the affected plants Boron in the form of borax was either applied to the soil or a solution of borax in water sprayed on the leaves of the affected plants All the plants treated were of the same age (about 7 years) and growing under the same soil climatic and cultural conditions The treatments were done on 26 5 47 and the observations were made at regular intervals

The results of this preliminary trial are reported in this note Exhaustive field trials and cultural experiments are in progress and a detailed report will appear in due course

(1) *Robab Tenga* (*C grandis*) Six worst affected plants were selected and they were given the following treatments

> *Treatment A* Borax was applied in the soil all around the plant at the rate of 2 lbs per plant The soil was loosened by light hoeing and the borax thoroughly incorporated with the surface soil Two plants were so treated
>
> *Treatment B* Borax was applied in the soil all around the plant at the rate of 1 lb per plant soil was loosened by light hoeing and the borax thoroughly incorporated with the surface soil Two plants were so treated.
>
> *Treatment C* Two plants were kept as control No borax was applied

In *treatments A and B* no corking and splitting of the veins could be noticed in the new flushes of leaves which came forth after the treatment of the plants In treatment *A* a yellowing of some of the leaves however was noticed Irregular yellowish areas which later became yellow orange developed between the veins and along the margins and the tips of the leaves the condition being more prominent toward the tip This might be due to an excess of boron[6] the dosage of 2 lbs of borax per plant might be in excess of the requirement of the plant This point is under investigation. In plants treated with 1 lb of borax no such symptoms could be observed

In *treatment C* the corking and vein splitting symptoms became more pronounced and a larger number of the leaves became affected with the trouble The plants presented a more sickly appearance and there were more of curling of the leaves.

(2) *Karun Jamir* (*C aurantium*)—Eight worst affected plants were selected and they were given the following treatments

> *Treatment D* Borax was applied in the soil all around the plant at the rate of 1 lb per plant. The soil was loosened with light hoeing and the borax thoroughly mixed with the top soil. Two plants were so treated
>
> *Treatment E* A spray fluid was prepared by mixing one ounce of borax with 3 gallons of water This fluid was then sprayed on the foliage of the plant care being taken to cover both the dorsal and the ventral surfaces of the leaves very thoroughly Two plants were so treated and for each plant 1½ gallons of the spray were used
>
> *Treatment F* A spray fluid was prepared by mixing two ounces of borax per 3 gallons of water This fluid was then sprayed on the leaves of the affected plants care being taken to cover both the dorsal and the ventral surfaces of the plants very thoroughly The plants were so treated and 1½ gallons of the fluid were used per plant
>
> *Treatment G* Two plants were kept as controls No borax was applied either in the soil or on the leaf

All the *treatments D E and F* brought about definite improvement in the general appearance of the plants No corking and splitting of the veins and the midribs and the curling of the leaves could be noticed in the new flushes of leaves which came forth after the treatments The three treatments were found equally effective in ameliorating the trouble as no perceptible difference could be noticed between the treatments So far no recurrence of the troubles in the treated plants have been noticed

In *treatment G* the plants manifested more intensified symptoms of corking vein splitting and curling of the leaves and a larger number of the leaves were found affected

S Chowdhury
S Dutt

Office of the Mycologist to the
Government of Assam
Jorhat 21 9 1949

References

[1] Haas, A R C *Bot Gaz* *89* 410 413 1930
[2] ——— and L J Klota *Bot. Gas* *92* 94 100 1931a.
[3] ——— & ——— *Hilgardia* *5* 175–196 1931b
[4] Morris, A. A *J Pomol & Hort Sci* *16*(2) 167 181 1938.
[5] Chapman H D G F Liebig J R and A P Vanselow *Soil Sci Amer Proc* *4* 1939 196 200 1940
[6] ——— & W P Kelley Citrus Industry *I* 749 1943 by Weber & Batchelor 749 1943

VERTICAL DISTRIBUTION OF ATMOSPHERIC OZONE IN LOW LATITUDES

I

Malurkar[1] has made comments on our paper[2] where we did not discuss the question of the low temperatures of the tropical tropopause but after describing our experiments and the results that followed from them, we summarised in conclusion our knowledge of the vertical distribution of ozone in different latitudes and its probable causes For the purpose of our paper, we believe that the references given were adequate We mentioned Ewell's paper[3] on the photolysis of ozone in the presence of water vapour 'as an example' He had worked with concentrations as low as those met with in the atmosphere and his paper contains references to previous work

One of the authors attended Mr Malurkar's lecture in Bombay in 1946 The points (1) that there was a secondary minimum of ozone content during the Indian monsoon and (2) the equilibrium ozone concentration would be adversely affected by water vapour when irradiated by ultraviolet light were already available in the published literature Mr Malurkar however made an explicit statement that the low ozone content of the tropical atmosphere may be due to the photolysis of ozone in the presence of water vapour

K R Ramanathan
R V Karandikar

Ahmedabad
11-10 1949

REFERENCES

[1] Malurkar, S L *Science and Culture*, *15* 118, 1949
[2] Ramanathan, K R and Karandikar, R V *Proc. Ind. Acad Sc*, *29*, 220, 1949
[3] Ewell, *Jr App Phy*, *13* 759, 1942

II

One of the outstanding results obtained by Dobson *et al* was that the low temperature of the tropical tropopause could be explained as a result of decreasing the amount of atmospheric ozone and increasing the amount of water vapour in the lower stratosphere This could hardly be omitted by me while describing their other conclusions regarding distribution of ozone in different air masses obtained from a simultaneous reference to synoptic charts To an extent the difference in ozone content in the air masses may perhaps be imputed to advection from different latitudes I have not made a suggestion that Ramanathan and Karandikar discussed the problem of the low temperatures of the tropical tropopause but that their conclusions had a good connection with the subject of ozone content in different air masses

The experiments of Forbes and Heidt referred to in my earlier letter were on photolysis of ozone with partial pressures of 10 mm to one atmosphere in the presence of saturated water vapour and ultra-violet light

Quoting from the discussion in paper by Karandikar and Ramanathan, ' In the tropics, most of ozone is in the stratosphere and its amount is largely controlled by the photochemical actions causing its formation and decomposition These do not vary much during the year The tropospheric convective processes which carry water vapour and other particles into the upper part of the troposphere apparently tend to destroy any ozone that might come down from the stratosphere Laboratory experiments confirm this" The reference given under the first sentence is to the work of Chapman and of Wulf and Deming and for the last sentence to Ewell I have once again looked into Chapman's and Wulf and Deming's papers There is no mention of the role of water vapour in photolysing ozone in the atmosphere In fact the assumptions of Wulf and Deming that there is little interaction between ozone and mother molecules have been taken for granted In the series of papers constituting the Garriot Committee report for 1943 and published along with Chapman's paper, the application of the photolysis of ozone due to water vapour is not made to the atmosphere In Dobson's conclusions also, he stated that 'for reasons that are not yet fully known, the amount of ozone and probably the ratio of ozone to water vapour is greater over the polar regions than over the equator' 'The suggestion of photolysis of atmospheric ozone in presence of water vapour and ultra-violet light (i e, bringing 1 and 2 of the para three in the above authors remarks) is not therefore a straight application of 'facts already available in the published literature' or of data from laboratory experiments The importance of the photolysis of ozone in the atmosphere due to ultra violet light as put forward in many of the earlier papers can hardly be overstressed But the additional photolysis of the ozone in the atmosphere due to water vapour and ultra violet light would, I thought, be useful to explain the diminution of ozone in the equatorial latitudes and ultimately help in solving the puzzling problem of the low temperature of the tropical tropopause

S L MALURKAR

Colaba Observatory, Bombay
12 2 1950

MANUFACTURE OF VITAMINISED *DALER BADI* (little balls of split pulses) AND ITS NUTRITIONAL AND ECONOMIC SIGNIFICANCE

For some years past the American nutrition experts have been experimenting on the method of artificial enrichment of white rice with vitamins and now they have commenced field experiments on the rice eating population of the Philippines with this enriched rice by preparing it on large scale The result of these experiments has appeared in the August 1949 issue of the *Journal of Nutrition* published from Philadelphia

It cannot be denied that we, who take white flour or milled rice are in gross short supply of vitamin B_1, Niacin and other vitamins of the B group, some of which are essential factors for carbohydrate metabolism And we really require enrichment of our staple dietary with these factors This can be effected in the manner stated here

In Bengal villages, almost every household prepares *badi* (little balls of split pulses) in winter It is palatable and can be used in any form, by simply frying it or by introducing it into fish or vegetable curry The method of preparation enhances the digestibility of pulses and adds to the protein intake of individuals As majority of Indian people have to derive their protein intake solely from pulses and vegetables the daily intake of this *badi* will prove of great help in this direction

If proper arrangements are made for the manufacture of *badi* under hygienic conditions by responsible persons and they are enriched with adequate amounts of the vitamins mentioned above by introducing them to the broth of mill pressed soaked pulses the article may prove a very nice vitaminised component to our dietary For this manufacturing process we need

(1) Clean enamel vats for soaking the pulses in water

(2) Ball mills to powder the soaked pulses,

(3) Mixing vat with mechanical stirrer (during this operation adequate amounts of the vitamins should be incorporated

(4) Appropriate dropper to drop *badi* on clean enamel trays

(5) Vacuum dryer for drying the *badi*

(6) Packing in suitable tins or cardboard boxes

When prepared on large scale the cost of the stuff would be within easy reach of our people Though at present we shall have to import most of the B-vitamins as we are so long doing it for the preparation of medicinal tablets and other preparations we may eventually start manufacturing most of the important B vitamins on Indian soil

These when incorporated in fish or vegetable curry the loss of their vitamin content would be negligible and it can be consumed with relish both by rice eaters and bread eaters alike With the aid of vacuum drier we can prepare *badi* all the year round irrespective of sunny or rainy days

Finally if this plan be speedily worked out an extra amount of pulses in the shape of this article in our dietary will lessen the consumption of rice to a corresponding magnitude

HARA GOPAL BISWAS
Bengal Chemical & Pharmaceutical Works Ltd
164, Maniktala Main Road
Calcutta-11 1-12-1949

IONIC ANTAGONISM IN CATION EXCHANGE REACTIONS—I

The individual characteristics of the cations in exchange reactions become manifest in the unmistakable lyotrope effect[1] Symmetry value has been found to be a reliable measure of this effect In determining this value the added cation is made equivalent in amount to that present originally in the exchange substance The exchanging powers of different cations may then be compared by determining the amounts of exchange of a particular cation caused by each of them[2, 1] Here one cation replaces another The problem is simpler than what happens when a second cation competes with the first This competitive reaction, often resulting in antagonistic effects has been quite extensively studied in the case of the coagulation of colloids[3] In cation exchange in soils and clays such competitive reactions are important in so far as they determine the availability of nutrient ions for the growth of plants but they have not been very systematically studied The present note deals with the results obtained with colloidal solutions of some bentonite salts The bentonite used here is entirely constituted of a clay mineral called montmorillonite which possesses a high cation exchange capacity and is therefore a very suitable material for the type of investigation in question

The competitive reaction was studied by adding a mixture of cations to a clay saturated with a different cation and estimating the amounts of each entering the clay by exchange This was compared with the symmetry value, which is a measure of the exchanging power of the cations and also with the amounts of exchange each of the competing cations yields when added separately This was done with a large number of combinations of cation mixtures

The analysis of the large mass of data shows all possible types of ionic interactions For instance we have (i) superadditivity (ii) additivity and (iii) antagonism Additivity which according to the measurements made was more an exception than a rule would be expected if the cations act independently of each other A value in excess of that demanded by additivity has been termed superadditivity[3] and a deficit from the same as antagonism In the few cases of superadditivity it has more often been found that the exchanging power of one cation is very much heightened at the expense of the suppression of the companion ion and the algebraic sum of the effects exceeds the value demanded by the additivity principle Several examples are shown below

	Electrolytes	*Obsd total Exchange*	*Calcd total exchange from separate expts*	*Remarks*
Na bentonite	$KCl + NH_4Cl$	52 6	72 4	antagonism
	$NH_4Cl + BaCl_2$	58 1	79 3	
	$MgCl_2 + BaCl_2$	88 9	87 0	additivity
NH_4 bentonite	$KCl + NaCl$	57 7	43 3	Superadditivity
	$KCl + CaCl_2$	77 9	56 7	
K bentonite	$NaCl + MgCl_2$	58 2	59 1	additivity
	$NaCl + BaCl_2$	31 7	50 9	antagonism
	$MgCl_2 + BaCl_2$	50 2	64 2	
	$NH_4Cl + BaCl_2$	78 2	47 2	Superadditivity

It has been found that whereas the activity coefficients calculated according to Ostwald[4] indicates only the trend of variation of exchangeability they fail to explain the observations in the individual cases A consideration of the hydration of cations and its probable changes in a mixture helps in many cases to understand the observed antagonism

My thanks are due to Dr S K Mukherjee for his kind interest in the work

SHANKARANANDA MOOKERJEE
University College of Science & Technology,
92, Upper Circular Road Calcutta
5-12 1949

REFERENCES

[1] Jenny—*J Phys Chem.* 37 2217, 1932
[2] Mukherjee—*Ind Soc Soil Sci Bul* No 4, 1942
[3] Vester—Diss Utrecht 1935
[4] Ostwald—*Koll Zeit* 73 301 1935; *75* 39, 1936 *80* 186 1937

VIVIPARY IN *ARTOCARPUS INTEGRIFOLIA* LINN

Artocarpus integrifolia Linn is a large evergreen tree which occurs wild in the forests of the Eastern Ghats and also is largely cultivated in the deltaic areas of the Krishna and the Godavari The plants are grown in those parts more specially for the edible fruits and also for timber which is yellowish and used for articles of furniture

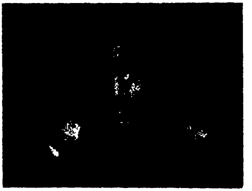


Fig 1

The plants are monocious the male flowers occur in pseudo catkins and the female in pseudo heads On development a multiple fruit is formed and the achenes are surrounded by the fleshy perianth

In July 1949 a number of achenes were observed, showing curiously various stages of germination while inside, when a fruit is cut open Some of the stages of germination observed show the emergence of the cotyledons more than half of their length out of the seed splitting the horny testa (Fig 1)

Vivipary as characteristic of the mangroves *Rhizophora* and the allied genera is an oecological necessity induced due to the peculiar environment The phenomenon of vivipary exhibited in the present instance seems to be only a physiological necessity with no oecological significance induced by the temporary external favourable conditions for the germination of the seeds Generally the fruits are kept long in storage before they are disposed and the over-ripening of the fruit in storage must have set the physiological processes like respiration etc starting, and resulting in the germination of the seeds

V VENKATESWARLU
J L KANTA RAO

Department of Natural Science,
Hindu College Masulipatam.
11-1 1950

WHEAT RUSTS FROM MADRAS

Wheat occupies a minor position among the cereals cultivated in this province but it has assumed importance owing to the belief entertained in some quarters that the hill stations of this province form the foci of infection of rusts to Peninsular India[3] Two crops of wheat are raised on the hills and only one cold weather crop, in some districts of the plains of this province Consequent on the belief mentioned above the cultivation of the summer crop has been banned in this province for 3 years from 1948 Some observations made on the occurrence of the three rusts in Madras Province are recorded below

Black rust—(*Puccinia graminis tritici* (Pers) (Eriks & Henn) On the Nilgiris and Pulneys *Triticum dicoccum* (local *samba*) is the species of wheat commonly cultivated In some villages of the former locality small patches of *T vulgare* are sometimes grown (especially N P III *Bola* wheat etc) Black rust is very rare on the Pulneys and during the surveys in 1947 and 1949 no incidence of this rust was noticed in this area On the Nilgiris black rust has been observed on *T vulgare* and barley, the local *samba* wheat is conspicuously free from this rust In some fields mixtures of *T dicoccum* and *T vulgare* could be seen It was interesting to note the occurrence of black rust on the latter but not on the former, though growing by the side of infected *vulgare* plants In 1948 when a ban was imposed on the cultivation of summer wheat (April to September) in this province black rust was noticed causing 80 to 100 per cent crop infection in December at Coimbatore and Bellary while there was no black rust on the Nilgiris on the second crop of wheat In 1949, black rust was prevalent at Coimbatore in the last week of December when it was absent on the Nilgiris These indicate that the wheat crop of the hills do not form the foci of infection for outbreaks of black rust incidence in the plains Other sources of infection must be sought

Brown rust—(*Puccinia triticina* Eriks) This is prevalent all over the province and has been recorded on *T dicoccum* and *T vulgare*, year after year Butler and Hayman[1] have stated that the telial stage of this rust "does not usually or habitually develop in India" Prasada[4] writes that the telial stage of this rust "is very scarce and often impossible to obtain in this country" However, under the conditions prevailing in Coimbatore and Nilgiris abundant formation of telia have been observed almost every year in December to March The telia are mostly hypophyllous on the leaf blade but are also present on the sheath. These form one of the common specimens used for teaching purposes year after year in this college

Yellow rust—(*Puccinia glumarum* (Schm) (Eriks & Henn.) This rust is found on *T dicoccum* and barley on the Nilgiris and Pulneys But it has not been observed in the plains districts of this province In the last week of 1949 this rust was found to have severely infected a small crop of *T dicoccum* at Kodaikanal and almost completely destroyed the plants Besides infecting wheat plants leaf infection of *Bromus catharticus* Vahl (*B unioloides* H B K) was evident on the plants growing round the infected wheat plots This is the first record of this rust on this host in India Arthur[2] has given this grass as one of the collateral hosts of this rust This is a perennial introduced grass which is slowly spreading on both the hill stations of this province and its role as a collateral host for yellow rust indicates the necessity for caution in allowing it to spread

T S RAMAKRISHNAN

Agricultural Research Institute
Coimbatore 20 1 1950

[1] Butler F J and Hayman J M *Mem Dep Agric Ind Bo Ser* 1 2 p 13 1906

[2] Arthur J C *Manual* of *rusts* in *America* and *Canada* p 186 1934

[3] Mehta, K C *Sci Mon 14* 219 1940

[4] Prasada R *Indian Phytopath 1* 121 1948

ON THE ROLE OF CELLULOSE IN FILTER PAPER CHROMATOGRAPHY

Since the introduction of Filter Paper Chromatography by Consden Gordon and Martin[1] the field of application of this elegant and promising technique is gradually gaining ground Various types of complex mixtures of natural organic compounds as well as synthetic products have been successfully separated identified and almost quantitatively estimated with the help of this technique The authors[1] have accepted it as a partition Chromatography according to them the separation depends on the differences in partition coefficient between the mobile phase and water saturated cellulose instead of differences in adsorption by the cellulose The assumption that *the cellulose is playing the role of an inert support* seems justified to them

For some time past, we were busy in collecting experimental facts of all the factors—(*i*) paper (*ii*) temperature (*iii*) quantity of amino acid (*iv*) extraneous substances, (*v*) degree of saturation with water and (*vi*) supply of solvent and the distance between the starting point and the source of solvent—which according to Consden *et al*[1] can influence the R_f values We have observed that the cellulose, in form of Filter Paper cannot play a completely inert role in Filter Paper Chromatography Recently Hanes and Isherwood[2] have proposed a hypothesis in which they have indicated that the pioneers' assumption of pure and simple partition in case of Filter Paper Chromatography is an oversimplification of the problem So we deem it a necessity to publish our observations

Cellulose in form of Filter Paper is capable of adsorption of amino acids and sugars with this idea we performed the descending as well as ascending Filter Paper Chromatography using pure water, instead of a solvent saturated with water It is clear that the use of simple water makes the process identical with Capillary Analysis But we have obtained constant R_f values of amino acids and sugars by this method The constancy of these values for a wide range of concentration will be obvious from the following Table

Glycine

Volume applied on paper	Amount of Glycine	R value (descending chromatography)
004 cc	1 µg	85
004 cc	2 µg	91
044 cc	3 µg	85
004 cc	4 µg	89
004 cc	5 µg	86
004 cc	10 µg	90
004 cc	15 µg	87
004 cc	20 µg	90

The following R_f values with simple water have been obtained in case of amino acids and sugars

Amino acids

N B R_f values for only those amino acids and sugars which we have been able to procure are given

004 c c containing 10 µg of the amino acid was applied in each case

Amino acids	R_f value (descending)	R_f value (ascending)
Glycine	84	86
Alanine	84	88
Tryptophane	57	57
Serine	85	88
Leucine	90	90
Phenylalanine	80	81
Threonine	85	92
Methionine	85	90
Aspartic Acid	90	95
Glutamic acid	91	94
Asparagin	88	80
Histidine*	79	86
Tyrosine*	78	78
Cystine*	92	89
Lysine*	89	88

*These were applied on paper as hydrochlorides and neutralised with ammonia vapour

Sugars

004 c c of 1% solution of the sugar was applied in each case.

Sugars	R_f values (descending)	R_f values (ascend
Glucose	93	92
Fructose	86	86
Lactose	86	86
Galactose	82	92
Xylose	84	91
Mannose	82	88
Arabinose	83	

When pure water is used as solvent no question of partition can arise We have no other alternative than to assume that the distribution of amino acids between cellulose and water leads to these R_f values, But the higher values of R_f in most cases clearly indicate, that the adsorption by Filter Paper is rather weak With these observations however, it is rather difficult to assume the completely inert role of cellulose when solvents saturated with water are used

If the role of cellulose were completely inert, the amino-acids and sugars should have moved with the solvent front and the corresponding R_f values should have been equal to 1

Our sincerest thanks are due to Dr D M Bose, Director, Bose Institute for his kind interest, encouragement and valuable criticism during the course of this work Our best thanks are also due to Prof S N Bose, Khaira Professor of Physics Calcutta University for some valuable suggestions

D P Burma
B Banerjee

Bose Research Institute
Calcutta, 23 1 1950

[1] Consden Gordon and Martin *Biochem J 38*, 224 1944

[2] Hanes and Isherwood *Nature, 164* 1107 1949

A NEW FIXATIVE FOR DIFFERENTIAL STAINING OF POLLEN GRAINS–III

The usefulness of the Aceto carmine technique for securing differential nuclear staining, in some cases, becomes impaired by the more or less strongly pronounced basophily of the cytoplasm, resulting in corresponding deterioration or total lack of differentiation This can, sometimes, be corrected by pre storing the material in alcohol or in Carnoy's fluid, or by suitable pre treatments[1 2] In the material so treated, the cytoplasm either does not stain or stains only faintly The differentiation is thereby improved We have now evolved and tried a new combination which has been found to give much better results

The mixture consists of N/NaOH in *absolute* alcohol to which sulphuric ether is added in the proportion of 9 1 When pollen which has been preserved in this mixture is treated with aceto-carmine, the generative nucleus becomes, almost immediately, brilliantly and differentially stained. The vegetative nucleus also, which otherwise does not stain at all or only very faintly,— *generally* stands out well-stained. The technique is, therefore, very useful in studying the cytology of otherwise refractory pollen grains. All that is necessary is to store the pollen in the medium overnight

We have, however, found that pollen of some species is not amenable even to this treatment. It is obvious from this, and from our other observations, that pollen grains of different plants (and even individual pollen grains of the same plant and pollen produced in *different* seasons), are of *different biochemical make-up* This is one of the problems we are trying to tackle. We have, however found it very elusive and difficult Mean while, it is our endeavour to discover a suitable *rapid* technique, which will give clear and, if possible, permanent differential staining in *all* cases

In connection with the technique now reported, it is to be noted that the nuclear morphology is somewhat adversely affected, and the grains themselves become disorganised if stored longer than four or five days We are making trials to ascertain the best proportions of the constituents suitable for better fixation and prolonged storage

The results of these trials will be published in due course *

N K Tiwary
Shnakerji Shrivastava

Botany Department,
Banaras Hindu University
28 12 1949

*These studies have been financed by the Scientific Research Committee of the U P Government.

[1] Tiwary, N K., *Science & Culture, 12*, 390, 1946.
[2] Tiwary, N K. & Shrivastava, Shankerji *ibid 9*, 37 38, 1949

BOOK REVIEWS

Scientific Instruments —Edited By H J Cooper, B Sc, A R C Sc I, A M I E E Hutchinson s Scientific and Technical Publications Pages vi+301 Price Rs 30/

Modern civilization may rightly be called an offspring of scientific and technological developments Progress in these directions, in their turn, have been dependent to a large extent on the design and manufacture of more and more complicated instruments. As an inevitable consequence of specialization, every branch of applied science has developed its peculiar instruments, a full description of which will demand a sizeable volume. In the book under review 18 writers have contributed 24 chapters on some selected scientific instruments. For specialists the book may not have much value but for persons working in allied branches it promises an interesting reading

The book is divided in 7 Sections Section 1 deals with some optical instruments. A brief description of the different spherical aberrations and the methods used to test them is given in Ch. I Ch. II gives an interesting account of aerial photography and the associated equipments. Recording and high speed cameras are briefly touched upon Ch III is on Illumination and Brightness measurement Ch IV, on Infra Red Seeing Devices, is the most interesting in this section The principle of Infra Red image converter, its war time development and application in tracking and firing at enemy points is very lucidly described

Section 2 is on Astronomical and Navigational Instruments Some common astronomical instruments, such as Coelostat, Heliometer Filar Microscope, Blink Microscope, Lyot Coronagraph, Schmidt Camera etc are described in Ch V In Ch VI an account is given of general meteorological elements and the instruments used to study them The next chapter deals with the application of electronic techniques in meteorological observations Ch VIII and IX describe important elements of aerial navigation and modern electronic methods of measuring and indicating them The next chapter brings an account of the modern methods of absolute and differential precision time measurement

In Section 3 Ch XI gives an account of some low and high voltage measuring instruments Current power and frequency measurements are also briefly touched upon The next chapter deals with electrical methods of measuring speed velocity vibration, extremely small changes in length, strain, moisture content, acidity (p*H* value) telemetering and principles of servo mechanism

Section 4 is on Electronic instruments Ch XIII is a brief survey of the commonly used circuits incorporating amplifiers, oscillators and relays Ch XIV is entirely devoted to the Cathode Ray Tube and its diverse applications Technological and general X ray techniques are given in Ch XV In Ch XVI an attempt has been made to give the salient features of Wilson Cloud Chamber Ionization Chamber, Geiger Counter, Cascade H V Accelerator etc

Section 5, comprising chapters XVII and XVIII is devoted to Material Testing Instruments Various types of Extensometer, Strain Gauges, Fatigue Machines etc are described Interesting methods of testing different physical properties of yarns and fabrics are given

Section 6 describes some of the commonly used Electrical, Mechanical and Sound recording instruments

The last 4 chapters constitute Section 7 Ch XXI gives a chronological description of Ship Model Testing The next chapter deals with the principles of Air craft Model Testing A historical account of development of Calculating Machines occurs in Ch XXIII The concluding chapter is a summary of the factors governing the design and manufacture of reliable scientific instruments

The inevitable incompleteness of the book—,and all books of a similar kind are perforce incomplete—, has been more than compensated by the addition of an exhaustive Bibliography at the end of each chapter There is a complete Index. Printing, blocks, and diagrams are all throughout on Art paper

R D.

Modern Text Book of Intermediate Physics Vol. II—By A N Banerjee Pp 568+vii Das Gupta & Co Ltd, 54/3 College Street, Calcutta 1950 Price Rs. 6/-

The present volume, which follows an earlier one published last year, deals with Light, Magnetism and Electricity upto the standard of the I Sc, course. The size of the type used in printing this book is as large as that in volume I and this has made the reading comfortable Suitable diagrams have been used abundantly to explain the fundamental principles clearly and each chapter has been followed by suitable numerical examples which will be much helpful to the examinees There are several chapters in this volume which have been written with much thoroughness and lucidity Of these mention may be made of chapters IX, X and XI in Light dealing with Optical Instruments, Spectroscopy and Colour respectively and chapters VII and IV in Electricity dealing respectively with Commercial Machinery etc and Modern Physics The index given at the end will be of great use to the students

The author seems to have made an attempt to remove the longfelt want of an up to date text book in Light, Electricity and Magnetism and he has been successful in this attempt The book has been beautifully got up and the price is quite moderate

S C S

A Text Book of Practical Physics—By S Venkataraman Pp xv+536 S Viswanathan, Ananda Book Depot, 14, Siganna Naick Street, Madras-1 1949 Price Rs 7/8/

This book is intended for students preparing for the B Sc degree of an Indian University The author has acknowledged his indebtedness in writing this volume to a large number of current text books of Practical Physics which includes among others those by Franklin and Nichols, Glazebrook and Shaw, Watson Kohlrausch, and Worsnop and Flint Evidently, an attempt has been made to collect the best features from these text books and to present them in a single volume The author seems to have been successful to a great extent in this attempt

In order to cover a wide range of standard in different branches of physics, beginning has been made in each of these branches with some elementary experiments and these have been followed by more advanced experiments some of which come up to the standard of B Sc Honours Course In General Physics, various methods of measuring surface tension of liquids, viscosity of liquids and gases, movements of inertia acceleration due to gravity and co-efficient of elasticity have been described and in some of these cases the theory has been discussed in detail In Sound, besides the methods of determining velocity of sound, Melde's experiment has also been included Similarly in Heat methods of determining co efficient of expansion, specific heat, latent heat, mechanical equivalent of heat, vapour pressure of liquids as well as some advanced experiments on thermal conductivity of good and bad conductors have been explained in detail

The experiments in Optics include a large number of advanced experiments, *e g*, determination of wavelength of light, using interference and diffraction patterns, finding resolving power of optical instruments and analysis of elliptically polarised light In Magnetism the experiments described are of common type excepting two experiments *e g*, verification of inverse square law with Hilberts' magnetic balance and determination of intensity of magnetic field at points along the axis of coil In Electricity most of the ordinary experiments on measurement of current, e m f, resistance, inductance and capacity have been described in detail Two experiments on magnetism, *e g*, drawing hysteresis loop for a given specimen of iron and determining permeability of iron have also been described in this section Methods of determining characteristic curve of a triode valve and efficiency of an electric motor have been given at the end of this section

The book would thus serve as a suitable text book both for the Pass and Honours B Sc Courses of the Calcutta University if only a few more advanced experiments were included Some of these are determination of vapour density of liquids, absolute frequency of tuning forks, dip of a magnetic needle using dip circle and electrochemical equivalent of silver Also a more exhaustive index would be useful to the students The book will, of course serve as a standard text book for Pass students

The book is not got up beautifully but in view of the large number of pages and figures, the price mentioned seems to be quite moderate

S C S

•

Advance in Applied Mechanics Vol I —Edited By Richard von Misses and Theodore von Kármán Academic Press Inc, 125 East, 23rd Street, New York 10 N Y, U S A Cloth 6″×9″ pp viii+293 1948 Price $ 6 80

It is difficult to define the scope and range of applied mechanics for it covers a very large number of subjects and spreads its tentacles over widely differing media It is therefore evident that advances in applied mechanics can be reviewed only by recording the developments in any particular subject only and not in general With this aim in view the editors of this volume have compiled a text recording advances in the major fields of boundary layer and compressible fluid flow and turbulence, elasticity, nonlinear mechanics and wave interaction problems Future volumes will, it is hoped, dwell into other related topics, for it is a well known fact as research in applied mechanics expands interconnections of seemingly distant fields become more apparent

The present volume contains in all six topics, *viz* developments in boundary layer flow by H L Dryden, non linear mechanics by Minorsky, survey of progress in elasticity in Holland, by Biezeno, mathemathical model study of turbulence by Burgers, numerical methods in wave interaction problems by H Geiringer, and Bergman's integration method in two-dimensional compressible flow, by R, Misses and M. Schiffer The first paper by Dryden comprising of some 40 pages forms an instructive review of laminar and turbulent flow in boundary layer His authority in the field of aeronautics enables him to give a masterly survey of the subject, which together with his lucid exposition and an exhaustive bibliography of 110 items, has resulted in a very important digress for aeronautical engineers

The second paper by Professor Minorsky of Standford University, California deals with the mathematical physics of non linear differential equations with one degree of freedom and where the parameter is a small number In some 60 pages comprising of compact mathematical analysis the author introduces the modern concept of non linear mechanics through the work of Poincare and van der Pol passing on to the phenomena of subharmonic resonance and parametric excitation The basic theoretical work on this subject was largely carried out in Russia by Mandlestam, Papalexi, Kryloff and Bogoliuboff, while Th von Kármán and Minorsky ('Introduction to Non-Linear Mechanics, Edward Brs Michigan, 1947) introduced the science in America To understand this branch of mechanics a reader requires an intrinsic knowledge of mathematics not usually acquired by a practising engineer This reviewer therefore feels that although this paper gives a very clear mathematical idea of the motions in a dynamic system, it does not reveal its applications in such fields as aeroelasticity, automatic control and servomechanism, theory of oscillations and vibration phenomena, and electronics, fields in which the readers of this volume are more interested The third paper on elasticity by C B Biezeno of the Technical University, Delft Holland, is the longest of all the papers (66 pages) and one which will interest a very wide circle of technologists In dealing with the subjects on the theory of elasticity and elastic stability plates and shells, theory of structure, and experimental stress analysis, the author mianly reviews the work of the three main centres *viz* Technische Hoogerschool at Delft, the Centrale Organisatic, voor Toegepaste Natuurwet en schappelijk Onderzoek at Hague, and the National Luchtvaartlaboratorium at Amsterdam In some 40 pages the work of the Applied Mechanics Laboratory of the Technical University, Delft is surveyed Beginning with the generalised theories of stability developed by Timoshenko, Bryan, Southwell, Hencky and others the author extends his work in the realms of elastic behaviour beyond the stability of the Dutch Central Inst for Technical and scientific Research, in fields of vibration and photoelasticity, covering some six pages The Aeronautical Research Laboratory at Amsterdam whose work is given in the last section, carries out important work in the valuation of second order stresses in the skin and ribs of wings, shell wing stresses, the tension field beyond the buckling stress, and the stability of sandwich plates The paper ends with a description of two technical publications *viz* "Technische Dynamik" by Biezeno and Grammel and "Plasticiteitalleer" by F K Th van Iterson As far as this reviewer is aware no English version of the former has so far appeared except for its review in *Nature* (Feb 1941) The second work on Plasticity has been published by Blackie & Son Ltd in English forms a compact digress on plasticity, and an extension to Nadai's classic work The fourth paper also comes from the Technical University of Holland, and dealing as it does with the classical problems of hydrodynamics and turbulence should have rightly been put after the first paper by Dryden To illustrate the theory of turbulence a mathematical model of a hydrodynamic system is illustrated Although the system adopted is very simple, it is capable of illustrating many features of turbulent motion such as the thin dissipation layers arising from small kinematic viscosity, the transfer of energy through the spectrum to high frequencies and the appearance of a finite limit to this spectrum The fifth paper by Hilda Geiringer is a report on the hydrodynamic shock problem, numerically treated with the use of Lagronge's form of equation of motion The methods adopted are applicable to problems ranging from one to three dimensions The last paper by one of the editors of this volume is a beautiful mathematical presentation of the range and power of analytic functions in problems of partial differential equations of the elliptic type The authors extend Bergman's method and by a straightforward procedure present the integration of Chaplygin's equation for a steady subsonic, irrotational and two dimensional flow The solution arrived at is also utilised in a special way for improving the Karman Tsien method for higher mach numbers The paper being highly mathematical in its content requires considerable knowledge of the subject to fully appreciate its value

The volume, has a fairly good author and subject index It will be useful to a wide circle of engineers who wish to keep themselves abreast of the rapidly expanding field of applied mechanics and mathematics

S K G

Spectroscopic Properties of Uranium Compound —By G H Dicke & A B F Duncan Pp 290 Published by McGraw Hill Book Co Inc, New York Price $ 2 75

This book forms part of the National Nuclear Energy Series, being Vol. 2 of Div. III dealing with Special Separation Project It discusses the spectra of a number of uranium compounds and their preparation This series has been prepared as record of the research work done under the Manhattan Project, the name given to the farflung scientific and nuclear activities in the U S A which had as their objective the utilization of atomic energy for military purposes The book is divided into two parts the first part being devoted to the spectroscopic properties of Uranium compounds The compounds studied belong mostly to the uranyl group Different chapters are devoted to the X ray analysis of the crystal structure, fluorescence and absorption spectra of the uranyl compounds An attached bibliography of 20 pages shows that since 1919, innumberable studies of spectroscopic and optical properties of uranium compounds have been published, and the present reports cannot be said to have added very materially to our information on the subject Some new and interesting observations are given on the isotope effects in the fluorescence and absorption spectra of uranyl compounds with enriched U^{235} But as the authors remark 'for a determination of the concentration of U^{235} the method is at present not too useful A second part of the report is devoted to the synthesis of uranium compounds chiefly belonging to the uranyl group and the growth of crystals of such compounds In an appendix exhaustive tables of wavelength measurements in the absorption and fluorescence spectra of different uranyl compounds are given, which the authors hope may serve as foundation for future analysis, but they also warn, that attempting classification from wavelengths alone is never satisfactory In a concluding chapter attention has been drawn to the enormous value of a detailed spectroscopic study of uranium compounds for an understanding of the structure of matter, particularly of the solid state

The reviewer feels a little disappointed in not finding certain information he was looking for in the report *viz* on the preparation of intermediate compounds from which uranium metal in a pure state has been obtained, and on the carrier distillation methods of spectroscopic analysis of the purity of uranium metal and oxides Probably if they are not still in the classified list, they will be included in future reports

D M B

Summaries of Sectional Presidential Addresses at the Indian Science Congress, Poona, 1950

STATISTICS

SAMPLE SURVEYS IN AGRICULTURE

P V SUKHATME

SPEAKING on the theory and practice of Sampling as applied in Agriculture during the last decade, Dr Sukhatme referred to the improvement in the method of estimation of yield statistics of food crops The official method, in vogue for the last 70 years, was now known to be highly unsatisfactory in its results and out of date Of the two factors which go to make the total production for a given year, *viz* , the area and the average yield, the former, in the temporary settled parts at least is fairly accurately known but the average yield calculated as the product of a 'normal' yield and the yearly condition factor has been known to be grossly defective not only because the supposed normal is a misnomer, since it seldom agreed with the average over a series of years but because the condition factor is purely subjective depending upon the vagaries of the staff responsible for reporting it Pioneer efforts to place the method of yield estimation on an objective footing by the employment of sample surveys were made by earlier workers in India but their methods had not been able to make an appeal to the administration The contribution of the Indian Council of Agricultural Research has been to demonstrate that a method of random sampling could be devised which would fit in with the administrative back ground of the country, which would be wieldy in the hands of routine administrative staff, which would not be prohibitively costly and would give estimates of production for important administrative units with a fairly high precision A series of sample surveys initiated in 1944 on wheat and paddy and subsequently extended to almost all the area under these crops in India and to other crops, showed that the provincial yield estimates could be determined with high precision and revealed that official forecasts in the various provinces had a definite tendency for bias and also lacked the susceptibility to seasonal fluctuation to the degree found in the sampling method

The design best suited for these surveys was the stratified multi-stage sampling By adopting revenue inspectors' circles as the strata and sampling 2 to 6 villages in a stratum depending upon the area under the crop, 2 to 3 fields in each selected village and harvesting 1/80th acre plot in each selected field, the district yields could be estimated with sampling errors approaching 5 per cent The surveys were the largest of their kind carried out anywhere in the world

Dr Sukhatme then went on to describe the more important results in the sampling theory reached in course of these investigations He gave the theory appropriate for the estimation of gains in precision due to stratification in a sub sampling design and showed that the results of earlier workers in the field by Cochran and Yates were special cases of those derived by him Based on the same results, he indicated an approach for calculating the relative efficiency of (1) the different size sampling units, (2) of one versus two stage sampling and (3) weighted versus unweighted mean as a method of estimation in a sub sampling design By far the most revealing conclusion of scientific, administrative and popular interest was that the use of extremely small size plots much in favour in countries like U S A and U K and used in earlier attempts in India was ill suited for adoption under the field set up and crop conditions in India, since it almost invariably resulted in over estimation of yield

Other important applications of the sampling method were to diverse problems such as the estimation of pre harvesting areas, which, in contrast to actually enumerated areas are of poor reliability livestock population and cattle yard manure These enquiries were yet of a pilot nature but the results obtained had already shown that with a reasonably small sample and appropriate design of the enquiry, the respective estimates could be obtained with fairly high precision

Dr Sukhatme finally said that a virgin field for the employment of sampling surveys was the study of the effect of Grow More Food Campaign The country needs to know how much we really benefit from the Campaign, how much we expected to benefit and how much we expect, if resources are utilised on the principle of optimum allocation Investigations aimed at answering these questions were, he said, really "operational research" in the field of food and agriculture and ought, as such, to receive top priority

That this had not so far happened was rather unfortunate, but he hoped that the appreciation shown by the Government in regard to the improvement of yield statistics of food crops, for which a 5-year coordinated scheme for extending the use of random sample method to all crops and over all the territories had received approval, will also be extended to placing the statistics of the Grow More Food Campaign on a sound basis

PHYSICS

ROOM ACOUSTICS AND ULTRASONICS

R N GHOSH

STARTING with the classical work of Prof C V Raman on the theory of the violin and its experimental verification by means of his mechanically played violin, Dr Ghosh traced the history of the development of this branch of physics in India Prof Raman s researches in violin were followed up by the American workers, and the researches finally led to the discovery of the properties of Stradivarious Violin and to its duplication at small costs In this context Prof Raman's work on the impact of painoforte hammer has to be introduced, after the publication of this work a large number of Indian workers followed the problem of 'impact of pianoforte hammer and the results stand as a landmark in the history of acoustics in India Similarly the discovery of the laws of diffraction of ultrasonic waves by Prof Raman and Nagendra Nath represent another great scientific achievement in acoustics

Dr Ghosh then dealt with the developments of modern acoustics chiefly that of room acoustics It is presumed by engineers that the last word on room acoustics is represented by Sabine s law while Dr Ghosh emphasised that caustion and rare are necessary in the application of Sabine s law and a physicist s collaboration is necessary in problems of acoustics correction of the architectural constructions Since the days of Sabine many experimental facts accumulated These could be explained by the wave solution with the help of the boundary conditions of the walls

Three sets of orthogonal function are obtained of which the wave length and absorption parameters depend upon the nature of wall impedance and the type of the wave It is found that irregular distribution of sound absorbing patches or non geometrical shapes of rooms are more favourable to Sabine conditions and better room acoustics

Dr Ghosh then drew attention to the production and manufacture of suitable apparatus in India The equipments necessary for the work on room acoustics and noise are costly and Indian workers had worked with apparatus which they could themselves make or import from outside Preliminary work in this direction has been done by Bhatt and Subramanium but this work has to be followed in a commercial scale With acoustical consciousness the attention has to be directed to the discovery of suitable material for sound absorption Dr Ghosh's own work has been extensive and up to-date and the address includes the various methods used for the accurate measurement of the acoustic impedance of materials A material with negative reactance is a very suitable one for sound absorption

A few examples of the application of Heaviside calculus to the problem of impact of pianoforte, or the air flow through chink of periodically varying width have been discussed very elegantly by this method

The end of the address discusses the ultrasonic absorption by liquids and the mechanism of this absorption Dr Ghosh has stressed that the semicrystalline structure of the liquid states is responsible for a major part of the absorption of ultrasonic energy which is also quantised (Kothari and Auluck) in addition the vibrational energy may also be present for instance in the case of acetic acid the vibrational energy is 3920 Cal

Lastly attention is drawn to the demand for the manufacture of acoustical apparatus in India There is no dearth of men or talent and work has already been done by Bhatt and Subramanium but it is expected that industrialists should come forward and collect workers exclusively for this kind of work so that the technique suitable for the manufacture of acoustical apparatus for industrial and public use may be perfected

MEDICAL AND VETERINARY SCIENCES

NUTRITION AND DEFICIENCY DISEASES

M V RADHAKRISHNA RAO

SPEAKING on the subject of nutrition and deficiency diseases in India Dr Rao said in a country like ours, where famine pestilence, ignorance and religious superstitions are rife, the incidence of diseases or disorders due to faulty or inadequate nutrition is obviously very high The large scale migration of population from one dominion to the other since the partition of the country had, among other problems created the problem of providing adequate diet to the displaced persons, This coupled with the present-day scarcity of food in the country are specially responsible for the incidence of deficiency states amongst a section of the country s population at the present time

As a result of opportunities thus provided to the nutrition workers in recent times, certain clinical disorders which had remained obscure so far were traced to deficiencies in the diet The author discusses such clinical conditions associated with mal nutrition

Phrynoderma (toad-skin) This is a popular lesion of the skin present mostly on the outer surfaces of the arms and thighs It is generally associated with dry and rough skin and with changes in the eyes such as night blindness, dryness of conjunctive and keratomalacia Beneficial effect of oral treatment with vitamin A concentrate supports the view that vitamin A deficiency is the predominant factor in its causation

Nutritional Diarrhœa Clinical experience and experimental work has shown that the health of the the small intestine is dependent on good nutrition and deficient diet may produce irreversible changes in the gut In the Relief Camps in Bombay Province the author came across cases of chronic diarrhœa refractory to any known specific treatment and yet amenable to simple dietetic treatment which included administration of plenty of butter milk and over ripe bananas

Hypoproteinaemia The deficient intake of protein for economic or other reasons results in a deficiency state which manifests itself by swelling of feet general anasarca and ascites (fluid in abdomen and is associated with varying degrees of anæmia Such cases were studied among the displaced persons in Relief Camps in Bombay Province They improved remarkably with high protein diet consisting of Full Diet and dried milk or egg powder in the preparations of chapaties' Our idea of using proteins in the powder form with wheat flour is perhaps a novel one, but the author's experience encourages one to proceed in this direction and shortly come forward with some definite conclusion about the quantity and mode of its use

Cirrhosis of the Liver Portal cirrhosis in India is associated with nutritional deficiency The clinical trials suggest that a good nutritious diet containing liberal amounts of essential amino-acids (break down products of proteins) and vitamin B complex may have a beneficial effect on the clinical course of the disease if treatment is instituted early in the decompensated stage

Tropical Ulcer The greater incidence of tropical ulcer or Naga Sore" in certain parts of India such as Assam and East Khandesh in recent years has been attributed to the scarcity conditions prevalent in these areas It is suggested that malnutrition plays a predominant part in the causation of the condition and in the rapid spread and delayed healing of the ulcer

Since the Government began taking adequate measures to improve the nutritional status of the general population by a system of rationing of essential food stuffs and equitable distribution cases of tropical ulcer have gradually declined in number, and it is now an exception rather than the rule to see a case

PHYSIOLOGY

PHYSIOLOGY OF HEALTH AND PHYSICAL FITNESS

K MITRA

IN spite of unprecedented efflorescence of knowledge on Physiology and Medicine within the last hundred years, we do not as yet know how to categorise apparently healthy persons in different grades of positive health Our medical undergraduates are taught almost next to nothing on the technique for measurement of health levels In a spate of specialisation on the physiology of each of the different components of the body the fundamental fact has been overlooked that the human organism is an integrated whole and not simply a conglomeration of tissues, fluids and organs The incidence of lowered state of health in mass scale caused as a result of the two World Wars and the economic depression of thirties have brought into the forefront the necessity of establishing limits of the different grades of health or fitness and also the yardsticks that may be used for such assessment with reasonable precision In matters of relief, rehabilitation and rationing, the health authorities have often to assess whether one group of people is in a lowered state of health as compared to others The yardsticks for such an assessment have to be reliable, easy and quick of application The subject of optimum health and fitness have assumed a national importance today as no State can maintain its integrity and independence unless it can provide efficient and physically fit man power for its agriculture, industries and the defence services

Emergence of the concept of 'Nutrition as an individual entity within recent years and the studies carried out in this connexion have helped in adding to our meagre store of knowledge on the physiology of health and fitness of man The data collected during investigations on the influence of working conditions and environment on the health of labour populations have tended to clarify certain issues in this connexion A rather comprehensive effort to study the physiology of health and diagnostic methodology for assessment of nutritional levels was begun in early forties in no less than half a dozen universities of U S A In persons not actually ill, the state of health, fitness and nutrition often go together

As a necessary preliminary for future studies on the physiology of health the data collected in connexion with investigations made in different countries have to be thoroughly scrutinised in order to indicate lines of approach to the problem. Subsequently planned researches on the phenomenon of health, on national and international basis, the latter probably with the help of World Health Organization have to be sedulously pursued The departments of Hygiene and Physiology in the various medical colleges in India should establish effective liaison and collaborate research on this subject of national importance The three different phenomena of physique, organic efficiency and motor fitness of the body with their relation to health and well being have probably to be studied in this connexion. A plea has also been made so that pay scales in the scientific and administrative services be closely equated to ensure recruitment of top ranking university students in both of them instead of to the one in preference to the other

---

CHEMISTRY

THE UTILIZATION AND DISPOSAL OF INDUSTRIAL WASTES—THE NEED FOR A NATIONAL PROGRAMME

J K CHOWDHURY

CONSIDERING the size and population of the country, India is relatively poor in natural resources The supply of many essential minerals, fertilisers and other products is *far* from satisfactory It is imperative that we should try to widen our raw material position

Modern industrial operations extract only a small fraction of the raw materials as valuable marketable products Large quantities of foreign ingredients are discarded in the process and discharged into the air as gases or dusts and into the rivers as effluents These discharges pollute the air and water and cause considerable damage and annoyance to the public besides seriously endangering public health and aquatic life Recovery of useful products from these industrial wastes is therefore necessary not only in the interest of national economy but also of public welfare

Speaking on the exploitation of waste materials Dr Chowdhury referred to *Municipal Wastes* which consisted mainly of refuse matter and sewage He said sorting was the basis of the exploitation of refuse matter Female labour has been employed successfully for picking up important articles such as tin vessels non-ferrous metals, scrap iron, rags, paper glass, rubber goods etc from municipal refuse The residual organic matter is fermented in closed chambers when fuel gases and valuable organic manures are obtained

The discharge of sewage into streams and rivers creates a pollution problem of great magnitude The hygienic disposal of this obnoxious material has been combined successfully with its utilization for agricultural purposes In some places, sewage has been pumped to distant fields and left to weather The utility of such methods is greatly limited owing to their dependence on weather and soil conditions, and the methods can hardly be said to be hygienic Modern biological processes of utilization make use of numerous bacteria present in sewage 'Anaerobic' fermentation decomposes all organic matter with the generation of combustible gases and formation of some decomposition products which have to be subjected to further aerobic' fermentation either by the trickle filter method or by the activated sludge process. The final sludge is harmless, rich in nitrogen and used as a valuable manure The gases are rich in methane and are used as fuel for propulsion of motor vehicles or for generation of power The final effluents are either led into irrigation channels after chlorination or are pumped back into the fermenting vats after suitable treatment

Cellulosic raw materials used for pulp and paper industries contain large percentages of lignin and other organic substances which find little use Many interesting processes have now been developed for utilising these waste materials and recovering a part of the sulphur used in the extraction of cellulose The recent development of the 'closed system' has enabled complete recovery of waste fibres and sizing materials in the paper industry Low grade cellulosic materials have been used for the manufacture of high class fibre board, suitable for door panels, floorings etc Another interesting development is the incorporation of fibrous wastes with cement for the manufacture of various parts of prefabricated houses

Standing on the threshold of industrialisation, it is time for us to reflect on the raw material position on the one hand and the possible evil consequences of industrialisation on the other Only then shall we be able to devise and take appropriate measures for remedy Are we not throwing away some valuable materials which we need for our industrial and agricultural economy ? Are we taking care for the prevention of atmospheric and river pollution ? The answer is obvious—but the difficulty is that we do not know what is to be done and how to do it

The first prerequisite for tackling the problem is knowledge At present we lack knowledge of the character and quantity of wastes discharged individually and collectively by different industries We do not know the methods of control and reclamation, and lack fundamental data upon which these methods are to be based We do not know the minimum permissible limit of different contaminants in air and water In Europe the necessary information is collected by high level commissions, committees and research organisations set up by the State and the industry In England the existing position has been reviewed by the Royal Commission on River Pollution, the Royal Commission on Sewage Disposal and the Standing Committee on River Pollution, while the Research Institute on River Pollution is doing valuable work in collecting fundamental data In U S A the federal government, the States and the industries are each tackling the problem in their own spheres and the Special Advisory Committee on Water Pollution of the National Resources Committee have surveyed the position in detail Several Research Institutes have been founded all over the country by the Public Health Department, Universities and Industrial Organisations The co-operative efforts of various organisations have recently led to the establishment of the National Committee for Stream Improvement

The second important requirement is the setting up of an administrative authority vested with adequate power to promote and control waste treatment A programme of work on national lines can only be drawn up by the combined efforts of scientists, technicians, administrators and financiers Would an existing or reorganised Government Department be competent to undertake the task or should a separate organisation be set up for the purpose ?

Only a National Committee similar to the Royal Commission in England and National Resources Committee in USA can find satisfactory anwers to these questions The constitution of a National Committee should not be postponed indefinitely We have a duty to society We can shirk taking action for some years but we cannot shirk the consequences

---

PSYCHOLOGY AND EDUCATIONAL SCIENCE

PSYCHOLOGICAL RESEARCH IN INDIA

KALI PRASAD

PROGRESS of modern science is characterised by the uneven development of its three main branches *viz*, the relatively high degree of control which physical science has enabled us to acquire over inorganic nature, our still very rudimentary knowledge of biology and the almost complete absence of scientific psychology and sociology This unbalance between physical and technological development on the one hand and our relative ignorance of the social and psychological processes on the other, is a peculiar incongruity of modern times and unless it is corrected there is hardly any chance of social understanding and human progress But it cannot be corrected except by a *deliberate* modification of the physical environment Progress in social matters has to be striven for and planned as assiduously and carefully as in the world of physical phenomena Until this is achieved, civilisation will always be exposed to the threat of extinction by the very instruments which scientific technology continuously forges The danger could perhaps be averted if the emotional constitution of man is understood and reorganised, otherwise the combination of our present ignorance about the mechanisms of human motivation along with our knowledge of physical science is bound to wreck the fabric of society Our knowledge of man is extremely superficial and inadequate The social sciences have, therefore, a difficult task and in the crisis with which modern civilisation is faced the development of scientific psychology is an imperative necessity, for psychology is the basic foundation of all social science There is growing anxiety in modern man to understand man For this reason the modern century has been called a psychological century *par excellence*

Unfortunately, in India psychological research is still in its early infancy There are two fundamental problems in psychological research specially to be devised in the country *viz*, (1) constructive effort in systematic and experimental psychology, and (2) research in applied psychology especially in the fields of social psychology and educational psychology The two problems are bound together, and the approach would have to be both constructive and experimental or 'operational' and not speculative and explanatory This is imperative in view of the replacement of the Aristotelian by the Galilian mode of approach in psychology in recent time While physical and biological sciences today have shaken off the Aristotelian influence to a considerable extent, psychology is still under its dominance The contrast is best exemplified by the distinction between class-theory and field theory The change is already marked in discarding or radically modifying certain traditional postulates.

Educational psychology has obviously a very large scope with a bewildering variety of problems But our educational research problems which are in many fundamental ways different from those in Western countries cannot proceed on uncritical acceptance of foreign models We may broadly classify educational problems under four major heads

(1) Those concerning the individual, *i e*, the child, his educable capacity, his normalcy or otherwise etc, (2) those concerning processes or mechanisms of educations, like school organisations, curricula, examinations, syllabi etc ; (3) those relating to the determination of the fitness, aptitude, and individuality of the teacher, his emoluments, his economic and social status and (4) problems in education its relations to art, aesthetics and culture Some work has been attempted on some of the problems mentioned above But these have very limited application We have yet to have a scale of intelligence which would give a reliable measure of the intelligence of children The notorious unreliability of age records of children and great differences in the culture and social strata from which they come are serious difficulties that have effectively prevented the spread of the mental tests

movement in this country But these difficulties can be met to a large extent by large scale sampling from representative regions and careful adaptation of tests There are two other ways of overcoming this difficulty (1) by stressing psychological experimentation and (2) by developing achievement or accomplishment tests in education While there may be serious obstacles in the way of constructing a national intelligence test today, we can develop achievement or accomplishment tests for school children in school subjects such as reading, arithmetic spelling, social studies science, geography, languages etc For it is recognised that a well chosen and diversified set of educational tests must be broad and general in its reference and not too strictly limited to trivial details of a pupil s text book

Present day curriculum will have to be modified so as to allow room for different type of school books Educational texts are directed not only to the memory process and information, but to the problematic thinking, the drawing of inference from data, the application of generalisation to specific problems and situations, study, habits, practices appreciation, insight etc, Thus constructed they are apt to stress psychological processes generally and are bound to provide a clue to the understanding of a pupil's mental status

Lastly, performance tests will have to be used far more extensively than has been done so far They will appear to have special usefulness in the peculiar conditions of our country It is true that as a measure of general intelligence they show only medium to low correlation with customary criteria such as results on standard intelligence tests and school achievements But where the latter are not available as in our case performance tests may be the only means of ascertaining mental status When a national general intelligence tests is constructed they could be used as a valuable supplement

The psychologist must take advantage of the democratic process which is coming more and more to be recognised as a way of life which offers maximum opportunities for an individual s development It is true that we have not yet attained a satisfactory understanding of the process in our country, but we must help educate men and orient them to t and build in reactions which would develop it Strictly, the educator and the psychologists have to be one and they both must bend their energies to the great task of changing our attitudes and training us for democracy But the social psychologist must not aim at a dead homogeneity where individual differences are utterly levelled down and patterns of behaviour are thoroughly regimented The psychologist on the other hand, aims at what has been called orchestrated heterogeneity where individuals make their distinctive contribution and at the same time heighten the tone of the whole society

— —

ZOOLOGY AND ENTOMOLOGY

THE EVOLUTION OF APPLIED ENTOMOLOGY IN INDIA AND ITS FUTURE

B C BASU

DR Basu traced the development in India, of Agricultural Entomology Plant Protection and Quarantine Organization Forest Fntomology Medical Entomology, Veterinary Entomology, Entomology and Lac cultivation, Entomology and Silk industry and Bee keeping and honey and gave a detailed account of the research work done on each subject in India with more or less a complete list of research workers on each branch of this subject From his report is evident that workers in India played important part in the development of this branch of science

Agricultural Entomology and Plant Protection and Quarantine Organisation in India at the centre as well as in provinces, where they exist play important part in the reduction of huge damage in India to food grains sugarcane, tobacco, potato, cotton, jute and various kinds of fruits It has been estimated that India normally suffers as a result of damage caused by all manner of animal pests and plant diseases to growing crops and stored grain, a total loss of about 500 crores of rupees a year

Forest Entomology in India deals with devising methods for controls of insect pest of forest plants in India Undoubtedly more forest product is destroyed by pests diseases and fire than is utilised Heartwood borer of *sal*, defoliators of *teak* and *shisham* spike disease (insect borne) of *sandal* and many such are causing huge annual monetary loss to India Termite and borer control for Railways, Public Works and Army Departments are also concern of Forest Entomology

Medical Entomology has a brilliant chapter in India The insect transmission of malaria plague, relapsing fever, kalazar and guinea worms have all been discovered by investigators in India and that is a glorious record of which any country may be proud Huge amount of work has been done on various aspects of Medical Entomology in India Insects are responsible for a human mortality of over one and a half millions a year in India

Veterinary Entomology in India though of recent origin has produced very valuable work on various aspects of the subjects A significant portion of mortality amongst cattle and other livestock in India can be attributed to arthropodal invasion In live animals moreover they inflict a variety of damages namely defective growth decreased vigour lowered reproductive capacity and reduced production of milk meat egg wool hide and skin and work Considering the country s huge livestock population these damages are enormous and cost many crores of rupees annually

Entomology and lac silk and honey industries in India India produces more than 90% of the total world production of lac India earned over 15 crores of rupees for lac in 1920 Researches on lac insects in India have helped production of lac in India immensely

Indians were well versed in the manufacture of silk since 6000 years ago Sericulture is a perfect rural home industry and gives direct or indirect occupation to 270 000 people throughout the year Development of this industry will yield India crores of rupees and solve her unemployment question to a considerable extent

The rough estimate of the total output of the honey in India is placed at 50 00 000 lbs per annum This is 1/20th of the total which can be collected in India if the industry is properly organised and if bee keeping be extensively practised

In conclusion Dr Basu said that in the history of man insects have been responsible for more loss of life and destruction to property than that caused by wars floods earthquakes fires and famines combined He gave a plan for development of Applied Entomology in India and recommended for the creation of a Central Institute for Pure and Applied Entomology in India

---

GEOLOGY AND GEOGRAPHY

THE PROGRESS OF OIL PROSPECTING IN THE INDIAN UNION

J COATES

OIL Prospecting in the Indian Union started in 1866 with drilling in Assam only seven years after the drilling of the famous Drake well in Pennsylvania U S A which is usually accepted as the beginning of the modern Oil Industry

The earliest wells were drilled without guidance of science near oil seepages and as is likely to happen in such cases they found a little oil but not enough for commercial development The first wells at Digboi in 1889 gave rather more fortunate indications but on the whole the early prospecting results over the whole sub continent were discouraging and for another twenty years little prospecting was done

Then scientific hypotheses were gradually developed concerning the occurrence of oil particularly about the correlation of oil rocks and the favourable nature of anti clines Systematic geological surveys were started about 1908 by the Oil Companies to make a thorough regional examination of the oil possibilities

These surveys showed that in Eastern India surface signs of oil mainly confined to areas where the geological structure was too broken for accumulations on oil field scale while near the structure that did seem suitable there was never anything better than shows of gas which gave no definite promise of oil Test wells were therefore chosen to strike a balance between these conflicting factors

A sequence of wells in various places started between 1918 and 1925 on this basis did not however disclose any potential oilfields though it was held that there might still be hopes of success if some important problems found in most of these cases could be solved

Therefore while much drilling was done to extend the proved areas of the known oilfields at Digboi and Badarpur (the most promising places to find new oil) one particular area—Masimpur—was chosen for a concentration of effort towards solving the problems typical of the Surma Valley

At Masimpur there has been a series of test wells and a campaign of auxiliary core drilling involving more than 100 separate bore holes some over 5000 ft deep This effort has already expended more than 2 crores of rupees and although the last well was 1½ miles deep each difficulty surmounted has disclosed others ahead and the area is still not considered finally tested

During the war period Government ordered a cessation of all prospecting effort (including the extensive geophysical surveys which had been started to investigate the wide alluvial plains) so as to conserve material for the immediate production of oil Even now circumstances have not yet permitted a full resumption of prospecting effort but drilling has already been going on in Upper Assam at Tiru Hills where it has been proved very recently that the underground structure is unexpectedly unfavourable and the area is barren of oil In the south west plans are in hand for drilling at Masimpur and (in Tripura) at Rokhia should circumstances allow

There are other regions in India not completely without hope of oil but too speculative to be attractive at present Meanwhile the eastern belt of Tertiary rocks offers a sufficiency of prospects of the orthodox type the first task is to make a determined effort to overcome the obstacles which have led to such a relative lack of success in the past There seems every reason for sober hope that some measure of success will yet attend these efforts

AGRICULTURAL SCIENCES

PLANNING OF AGRICULTURAL DEVELOPMENT IN FUTURE

R L SETHI

THE address at the outset gives a brief account of the historical background which brought about the present conditions of scarcity and shortage and high prices of agricultural commodities in the country

The village self sufficiency being broken under the British rule and the land fertility being delapidated as a result of continued drain without replenishment the country is not producing so much as it should have and as it can The first and foremost problem is of the development of villages so as to make them worthwhile for the educated youngmen to go and settle there The second is of the replenishment of the soil by developing indigenous resources of manure as has been done in the neighbouring countries of China Japan and Korea for centuries past Wasteful method of burning cattle dung as fuel should be stopped and cattle urine and human excreta and other similar products which are being wasted at present should be utilised after proper composting The methods of soil conservation as applied to the cultivated lands in America and mixed farming are the other measures recommended to maintain soil fertility Mechanical cultivation as a labour saving device is another measure to which attention is drawn Besides heavy tractors required for reclaiming the waste land a suggestion is put forward for light type of machines capable of working on the ordinary holdings of cultivators of 15 20 acres It has also been advocated that rainfed (*Barani*) areas which consist of four fifths of the total cultivated land in the country should be developed by dry farming methods Valuable results have been achieved in the Bombay Presidency by application of such practices and it is held that by their extended use India will be more than self sufficient in respect of food and other agricultural commodities Tremendous loss is caused to agricultural crops by both weeds and insect pests and diseases and it is recommended that measures to control them by modern methods should be energetically pursued Also food crops of better nutritive quality should be raised so as to satisfy the requirements of the people with a smaller quantity Of the general problems the most important is that of the creation of Extension Service to translate the results of research to the cultivators fields There is at present a big gap existing between the Government farms and the cultivators fields and its bridging is extremely important to help the cause of greater production Finally suggestions are made for improving the quality of the staff The research staff should not be shifted and should be kept at their posts if they are found suitable throughout their career to enable them to become specialists as it happens in Europe and other outside countries

---

ANTHROPOLOGY AND ARCHAEOLOGY

PROBLEMS AND PROSPECTS OF INDIAN ANTHROPOLOGY

C VON FURER-HAIMENDORF

DR Haimendorf emphasized the need for a co ordination of anthropological and archaeological research in India In India there is a particular need for a time perspective For here we find on a comparatively narrow space a variety of population ranging from semi nomadic food gatherers to modern town dwellers While in most other parts of the world rising civilizations tended to eradicate or assimilate earlier and less advanced culture forms and history appears therefore as a succession of cultures one taking over from the other in India civilizations of very different level have coexisted for long periods This is so because geographical conditions and historic accident have enabled some of the older and less dynamic races to avoid conflict and subsequent eclipse by moving out of the way of ascending civilizations into refuge areas difficult of access and unattractive to the bearers of advanced civilizations Frequent repetitions of this process have resulted in an unparalleled accumulation of divergent culture types

Perhaps the most important discovery of recent years in the sphere of Indian prehistoric archaeology is the identification and the dating of the neolithic and chalcolithic culture strata which preceded the megalithic culture of South India Professor Wheeler s successful excavations in Brahmagiri have provided the key to a number of problems which had long puzzled the archaeologist and anthropologist interested in the early history of India To my mind the importance of these excavations to the anthropologist is twofold we are now able to date the megalithic culture in South India and we have for the first time a clear indication of the position of that neolithic industry which is characterized by the partly or wholly polished celt of pointed butt and oval cross section

Scanty as the archaeological material may still be the whole evidence suggests that the civilization characterised by the axe with pointed butt is the first major neolithic civilization of Southern and South Eastern Asia Where its origin lay cannot yet be said but we are probably justified in associating it with populations who first developed a neolithic economy *i.e*, an economy based on agriculture and involving a style of life far more settled than that of food gatherers and hunters While in most other parts of the world such a primitive agricultural economy of neolithic type belongs to the past in India there are numerous peoples whose culture pattern corresponds in most respects to that of neolithic man even though metal instruments obtained by trade and barter may long have replaced the earlier stone axes These people are the primitive forest tribes who practise a system of shifting cultivation which necessitates the periodical clearing of forest growth who use neither the plough nor wheeled transport, and who have usually no other domestic animals than dog pig and poultry Some forest tribes of the high ranges of Travancore and Cochin the Reddis and the Dires of the Eastern Ghats the Kolams and the Kamars of the Central Provinces and the Juang and Birhors of Orissa and Bihar are all typical examples of such an archaic type of agriculture

Further archaeological and linguistic research is necessary to clarify this problem but a correlation between the megalith builders of the iron age and the speakers of the Dravidian languages must at least be considered as a very serious possibility

Speaking on the problems of cultural connections between Asia and pre Columbian America Dr Haimendorf said Complementary to the recognition of parallel art style and ornamental motifs are the findings of recent botanical research into the origin of certain domestic plants It has long assumed that the cultivation of the sweet potato in Oceania is due to ancient contacts with America and it has now been made probable that the bottle gourd and certain varieties of cotton are of old world origin and have been introduced into America in pre-Columbian times. In this connection I may mention also the theory of Stonnor and Anderson, who hold that maize is an old world plant which was introduced into America from Southeast Asia. This revolutionary theory is based on investigations in the hills of Assam and Burma, which seem to show that the cultivation of maize by the Nagas and other hill tribes is much older than the European influence which had previously been considered responsible for introducing maize to that part of the world

In the second half of his address Dr von Fürer Haimendorf discussed the value of anthropology for the solution of practical problems of social readjustment and economic change, praticularly in the sphere of primitive aboriginal populations

In India social planning is to day being undertaken on a vast scale and ambitious plans for the development of backward areas are on the programme of most Provinces and States But to plan the social advance and economic betterment of aboriginal peoples without adequate anthropological knowledge is as impossible as it would be to undertake a programme of public health without the advice of medical experts As a concrete example for the value of the application of anthropological knowledge to an administrative problem Dr von Fürer Haimendorf described the part which anthropology has played in the schemes for aboriginal rehabilitation and education in Hyderabad State, where anthropologists have been closely associated with the administration of tribal areas

Dr von Fürer Haimendorf concluded by emphasizing that anthropology is not solely concerned with the more primitive forms of society but that it can contribute to a better understanding of any society even the most advanced Its techniques enable us to study the structure traditional values and psychological attitudes of societies other than our own and by furthering the understanding of diverse cultures anthropology can materially contribute to a prevention of conflicts and the growth of tolerance between communities and nations

SCIENCE AND CULTURE

A Monthly Journal of Natural and Cultural Sciences

Vol. 15 APRIL 1950 No. 10

NEED OF A COMPREHENSIVE PLANNING FOR DEVELOPMENT OF AGRICULTURE IN INDIA

IT may have appeared to our readers that we have of late, devoted a considerable space to the publication of topics dealing with agricultural and food situation in the country We did it consciously and purposely because we feel that the Government and the people should think and act more creatively on the grave situation the country is faced with Production of enough food for the people and sufficient agricultural commodities for Indian industries is the most important single problem before the country to day And the degree of its solution and the speed with which we can achieve it will determine the future course—economic and political—of our country for many years to come

We are already beginning to see the repercussions of the deficit food and cash crop production on the over all economy of the whole country Importation of cereals alone is currently draining off the country 130 crores of rupees every year, and in aggregate it has already depleted the country of several hundred crores of rupees during the past few years Paucity of the supply of raw materials is gradually leading two of India's most important and biggest industries, *viz* jute and cotton, to a path of major crisis This may have been of recent origin especially due to devaluation and non devaluation, and Pakistan's policy, but the country has got to ensure measures to produce enough of these raw materials to meet the requirements of industry or else to buy supplies from outside, but India at present has no surplus foreign exchanges to do so

The loss of such stupendous sums of money due to food importation is beginning to jeopardize all our post-War nation building schemes Multipurpose river valley schemes, which our leaders displayed so much and on which common people placed so much trust, are being affected due to cuts in financial appropriations Apart from supplying cheap electricity for industrial uses, these multipurpose river-valleys were meant to provide irrigation to millions of acres and to aid in the prevention of soil erosion and control of floods—so harmful to men and crops Expenditure on food importation is therefore, retarding execution of the food production schemes of the country The deficit economy of the country is also beginning to have repercussions on large scale reclamation projects It now appears that against an original estimate of 4 000 heavy tractors required to perform the projected reclamation of cultivable fallow land, India can now pay for 375 tractors only Originally India planned to import 500 000 tons of chemical fertilizer but lack of foreign exchange is putting an impediment to such a large scale importation

The above are only a few of the many similar instances that can be cited to show how India's deficit production of agricultural commodities is jeopardizing most of our *nation building* schemes But these deficit food productions are not of yesterday's origin The frequent food scarcities have demonstrated it very painfully, and it has now assumed a chronic aspect Years have passed by, reins of Government of the country has passed from alien hands to people's representatives, but unfortunately almost the same situation exists to day as it existed a few years ago Apart from Government claims that the country will be turned self sufficient (in food production) by December 31, 1951 (*now the target date is changed to March 31, 1952*) the common man does not find any signs that the situation is gradually improving in that direction nor it can be comprehended how the 4 million-ton deficit in food production be met

To become self sufficient in production of food commodities should not be considered an impossible task To increase the current food production by 10 to 15 per cent, by which amount the country is running short, is not an impossible task Agricultural knowledge and technological methods of production has improved so much during the past few decades that stepping up present yield by 10 to 15 per cent is not at all difficult and can be done within reasonable time provided there be proper planning and conscientious execution of the same Since 1940 the United States of America has increased her agricultural production by 33 per cent the United Kingdom could during the same period step up her food production by 30 per cent So why not we in India ? Scientific agricultural know how is no close preserve of any one nation *What has been possible elsewhere can surely be achieved here also* provided there is the WILL and unflinching resolution to carry out the WILL

Apart from having spent a few hundred crores of rupees in foreign exchanges to buy imported foodgrains since War II the Centre and the Provinces have expended so far about 50 crores of rupees on Grow More Food campaign and a like amount in subsidizing sale of rationed food commodities at the statutory fixed prices Even then the food supply position in the country continues to be the same and no substantial increase in production seems to have been achieved

It therefore becomes apparent that there is something basically wrong in the agricultural set up in the country The existing defects in the system need be remedied the agricultural departments at the Centre and at Provincial level are required to be revitalized and thoroughly reorganized before the desired target of agricultural production can be reached The existing set up has already proved its uselessness

We therefore especially arranged for the publication of a series of articles[1] embodying the results of a comprehensive study of the different aspects of agriculture of U S A admittedly the most agriculturally advanced country in the world to day Those articles dealt with all the major aspects of agriculture *viz* (*i*) organization (*ii*) agricultural finance and credit (*iii*) industrialization of cash crop production (*iv*) agricultural research and(*v*) how laboratory findings are placed in the hands of the farmers who can put them into practical uses A perusal of those accounts of that dynamic Department of Agriculture will in itself stimulate fresh thinking and will provide with many a lesson as to how we in India can revitalize our own agriculture While publishing those articles we on our part reviewed the present position of those specific aspects of Indian agriculture and provided in the accompanied editorials[2] expert advice as to how our existing agricultural departments can be reorganized, how several of the science departments of Indian universities can be harnessed for the purpose of agricultural teaching and research on the model of the land grant agricultural colleges and agricultural experiment stations in the United States We have shown how agricultural credit system can be reconstructed and what organization is needed for the purpose We suggested ways as to how to help industrialization of a few major commercial crops Lastly we have shown how research can help us to better our agricultural output and the ways in which laboratory knowledge can be placed in the hands of farmers for application in farming practices We believe our endeavour will not fail to draw the attention of the authorities and the people of the land

We feel convinced that one sided measures will not materially improve the situation The different problems are so much interlinked that they require simultaneous attacks from several aspects at times apparently unconventional actions We need research to gather new knowledge on several phases of agriculture to harvest bigger yield and better quality It needs adequate financial appropriations to finance research of both short and long term projects but more especially do we need to provide the farmers with loans to pay for improved seed manure and approved farm implements We need to do away with or appreciably cut short the official red tape to ensure that loan amounts seed and fertilizer reach the cultivator in time and not after the season is over Above all, we need adequate personnel to carry modern agricultural knowledge to the farmers for their uses Knowledge confined within the laboratory walls is useless it becomes productive only when placed at the hands of the actual tiller of the land to grow two blades of grass where he grew only one before

Whatever organization we may have on other aspects of agriculture we find a complete absence of any set up in the country comparable to the very serviceful Extension Service of the U S Department of Agriculture or the National Agricultural Advisory Service of the United Kingdom established as late as 1946 However meagre the country s research set up be it has to credit several breeds of high yielding crop plants and dairy stock Several strains of Pusa wheat a few strains of Coimbatore sugarcane etc are known to yield twice or thrice the amount compared with the farmers own varieties But we still see that the farmers ever adjoining the Government farms yet sow their own unimproved strains and harvest one half or even less quantity than the Government farms although there is no physical reason for this disparity Country s economy can hardly afford to spend money to raise high yielding strains or stock on one hand and not to utilize them for the common good of the country and the people Proper organization should therefore be created to ensure that these high yielders are grown widely over the country Two things are necessary to achieve this (*i*) the setting up of large seed multiplication farms so that there be enough supplies available to the farmers and (*ii*) the organization of an agricultural extension service on the model of the one in U S A or U K to popularize improved breeds of crops and livestock and to aid in other ways farmers who only can collectively help to produce more food in the country

---

[1] J C Saha. *Sci & Cul. 14*: 441-446, 488-494; *15*: 46-49, 127 134, 1949

[2] (*Editorials*) *Sci. & Cul. 14* 439-441 485 488; *15*: 43-46, 125 127, 1949.

But by past failures and unfulfilled promises, the Department of Agriculture of the Centre as well as of the States has lost faith and trust of the common cultivator Often he was pursuaded to sow Government supplied seeds only to find to his miseries that they failed to perform upto the promises Often he received his quota of fertilizer after the season passed by when he was given agricultural loan he received it far too late to be of any productive use to him These and countless other not-too pleasant past experiences in his dealings with Government agricultural departments have made him suspect even the honest and most sincere intentions of the agricultural departments

However apathetic he may have grown during the course of the past generations, his goodwill must be earned by persistent efforts—not by empty promises but by sure deeds This requires a complete change in the outlook of the officials of the agricultural departments and a new spirit down the ranks, a habit of demonstrating with their hands what they want the farmers to adopt and an extensive organization of extension staff to carry to every village knowledge regarding improved agricultural practices But they can be achieved only after a thorough reorganization has been effected in the agricultural structure of the country

AGRICULTURAL EXTENSION SERVICE IN THE UNITED STATES

J C SAHA

THE prosperity that is enjoyed by the farmers in the United States of America has been made possible by the rapid practical application to farming practices of the new knowledge gained in the laboratories and experimental farms of the U S Department of Agriculture and of the many agricultural experiment stations of the land grant (agricultural) colleges and universities of the 48 individual States One who has spent any length of time in U S A or made a study of the causes behind the agricultural advancement in the North America becomes at once amazed how quickly, effectively and efficiently the results of laboratory findings are placed in the hands of farmers for their use

Some of the areas and ways in which the U S Extension Service has achieved magnificent results during the past few decades include

> "Counselling on farm problems, securing application of the findings of research on the whole range of farm operations from land use soil treatment crop and livestock production to better farm management and business methods better homes and better farm and community living, working with rural youth, helping farmers solve problems through group action, mobilizing rural people to meet emergencies developing an understanding of the economic and social factors affecting family living and agriculture in general [1] (p 1)

ORIGIN

The Extension Service was established under terms of the Smith Lever Agricultural Extension Act of May 8 1914, as an agency under the organizational set up of the U S Department of Agriculture[2] The Act stipulated personal contact teaching methods among farmers to be financed by Federal grants and conducted co operatively through the land grant colleges of the individual States The Extension Service is entrusted with the responsibilities of making thus available throughout the country the findings of investigations in agriculture and home economics to those who can put the information into practical uses.

SCOPE OF OPERATION

The Extension Service aims to improve the economic welfare, health, family and community life of the rural population by making the results of agricultural research available to the farmers

Its sphere of activities includes co ordination of the agricultural and home economics co operative extension work of the U S Department of Agriculture and the land grant colleges and experiment stations of the individual States, it directs the country agricultural agents, home demonstration agents (women) and 4 H Clubs work It helps to organize county committees to render advisory assistance to war veterans and others wishing to take up agricultural pursuits as means of livelihood

Although the major items of extension programs are particularly directed towards farm and rural families, its effect is all pervading, as practical application of new technological development of more efficient methods of production cannot but contribute to the general welfare of the consumers at large and the country as a whole.

MODE OF OPERATION

The modus operandi of the Extension Service in agriculture and home economics are to help farmers and rural families to help themselves by acquainting them with latest utilitarian developments relative to problems facing the farm families or rural communities It aims to help people to attain, through their own initiative, a higher and more satisfying standard of living Nothing is done that may appear to be forced from the top Historically, the extension staff has recognized the propriety of, and necessity for, the co operation of the people themselves in determining problem emphasis in extension programs of the individual counties the methods employed for extension activities depend upon the nature of the problem in question More important of the extension methods used are

---

[1] Joint Committee Report on Extension Programs, Policies and Goals U S Department of Agriculture and Association of Land Grant Colleges and Universities, 1948.

[2] J C Saha. *Sci. & Cul 14*, 441-446, 1949

Individual Counselling The extension workers visit individual homes or farms and the farmers or homes to analyze their problems and counsel them as to the best way of solving specific problems Although a limited number of families can thus be attended to within any given time, its outstanding merit lies in its effectiveness Personal counsels are widely sought by farmers, multitudes of farmers and rural homes that possess telephones freely use that facilities to discuss their problems with extension personnel and get the required advices

Demonstrations on Farmers' Estates The practical demonstration method is effectively used to teach home and farm practices with effective results The nature of demonstration varies according to the major problems of a locality Where soil conservation is the pressing problem of a locality a badly eroded farm is selected for demonstration work The extension personnel aided by local volunteers and if necessary strengthened by a working party of the U S or State Soil Conservation Service personnel, help the farmer to put his farm into shape If pest or disease is the problem in a locality, the extension worker will stage an effective method of spraying or dusting By such means the Extension Service helps farmers in a locality to get acquainted with the technique of operation and explain to them the benefit resulting from the application of such modern practices

Meetings and Group Discussions This method of carrying extension information to farmers or rural communities is being extensively used for the last several years A great advantage of this method is that a large group of people can be served at a given time Liberal uses are made of films photographic slides and other kinds of visual aids

One of the essential features that distinguishes these meetings is their informality The farmers are encouraged to raise for discussion any points they might want information on This permits an exchange of views and pooling of information with the feeling that the extension personnel is not there to bestow on them good sermons only It is the human touch in understanding the farm communities' daily problems that has endeared these meetings to them and the love with which the extension works are received all over the United States

Leaflets and Bulletins Because of high percentage of literacy published teaching devices such as leaflets letters and bulletins often nicely illustrated, rank high among the various extension methods used Depending whether the problem is of local or national importance, the States land grant colleges or the U S Department of Agriculture publish such informative materials and are distributed free to any one on request

These publications deal with any conceivable phases of farm and rural community life from practical farming instructions to how to iron a shirt or how to be happy in family life The following figures will speak of the great popularity of such bulletins As of June 30, 1948, the number of copies distributed on requests are Home canning of fruits and vegetables—7 4 million copies, Removal of stains from fabric —3 0 million copies Farm poultry raising—1 7 million copies, Roses for the home —1 6 million copies, the Farm home garden—1 2 million copies, Home-made jellies jams and preserves—1 8 million copies, Growing annual flowers—1 1 million copies[8]

One thing that has enabled such wide distribution of the bulletins circulars etc is the provision in the act establishing the States agricultural experiment stations that Such bulletins or reports and the annual reports of said stations should be transmitted in the mails of the United States free of charge for the postage"[9]

Radio Possession of radio receiving sets is a common thing with average U S farmers Several of the land grant colleges maintain their own radio stations, others have specified time allotted to them by commercial radio stations Hundreds of county extension workers utilize radio facilities to carry extension knowledge to the farm and rural communities

Operational Units

The activities of the Extension Service are carried on county (the opposite number of a district in administrative status and usually equivalent to a sub division of an Indian province) basis Each county has usually one County Agricultural Agent, one Home Demonstration Agent (woman) and one 4 H Club Agent—indicating that each group specializes in one aspect of a mutually complementary programs of extension work These categories of agents, though paid from the joint Federal States and Counties funds, are under the administrative charge of the States extension services with headquarters at the land grant colleges The extension service at the States level is a department of the land grant college

Besides their official extension duties, the county extension personnel are actively encouraged to energetically co operate with other activities of the farm and rural community life

County Agricultural Agent The County Agricultural Agent is the central figure in all agricultural activities in a county He acts as the representative of the State and the Federal governments in all agricultural matters He acts as a clearing house of agricultural information, takes active part in organizing meetings and discussion groups, directs the farmer as to the best way of doing a thing or how to proceed with in receiving benefits from various State and Federal agricultural upliftment funds He is usually a graduate in agriculture with extensive training in extension methods.

---

[8] *USDA* August 30, 1948.

As of June 30, 1946 there were 4 624 County Agricultural Agents ard Assistant County Agricultural Agents on the roll in U S A

County Home Demonstration Agent Through group meetings, discussion circles practical demonstrations (such as jelly making food dressing sewing etc), house to house visits the Home Demonstration Agent helps housewives to understand how to save time and energy through application of modern devices how to clothe their families suitably and economically how to furnish and decorate their houses decently within their own income how to beautify their home premises Such activities assist housewives to develop confidence, to enjoy and pride in their contribution to family living

The County Home Demonstration Agent is a woman and is ordinarily a college graduate majoring in home economics. There were 3 077 County Home Demonstration Agents and Assistant County Home Demonstration Agents in employment on June 30 1946

County 4 H Club Agent The 4-H Club activities are designed to develop the agricultural homemaking and citizenship abilities of the rural youth Through 4 H Clubs* over 10 million rural boys and girls (of the age group 10 to 21) have been taught the habit of group actions and helped to acquire information or gain skills valuable to them as future farmers and homemakers

The programs of work of the members of 4 H Clubs include undertaking responsibility for field crops and livestock production and their marketing soil improvement or wild life conservation food preparation and serving making and caring for clothings home gardening, etc Boys and girls individually or in groups of a few undertake one or more work projects of their own choice work on them at leisure at their houses or parents farms In the meetings held once a month or so the boys and girls report on the results they have obtained and compare with those obtained by the other groups The boys and girls discuss their own experiences arrive at a decision as to the best way of doing a thing The 4 H Club agents or other non paid local leaders that are present in the Club meetings act as mere advisers and help the members arrive at right conslusions

Besides local meetings the 4 H Clubs meet once a year on State wise and in all—U S A gathering Besides reporting and discussion, a part of each meeting—local or national, is devoted to recreational activities

On July 1 1947 there were 558 paid workers employed as county 4 H Club workers known either as County 4 H Club Agents or Assistant Extension Agents

Specialist Extension Workers The personnel are training specialists in their own subjects and are expected to keep abreast with latest knowledge in their fields of specialization They keep the county extension workers advised of the latest developments of new scientific methods and help their application to local problems

The specialist extension staff consists of Extension Plant Pathlogists Extension Entomologists Extension Horticulturists and several specialists in other subjects, they are usually located at the headquarters of the land grant college of the State and are placed with the divisions of Plant Pathology Entomology etc as the case may be of the land grant college Their constant association with the research workers in the land grant college helps them to keep up with the latest knowledge in their respective fields

In 1947 there were in U S A 1 827 extension specialists in various agricultural subjects They work under the directions of the States dierctors of extension work

FINANCING EXTENSION ACTIVITIES

In 1948 appropriations for extension work in U S A totalled 58 5 million dollars (i e about 292 million of devalued Indian rupee) 47 per cent of the total funds came from Federal appropriations 29 3 per cent from individual State appropriations and 2 7 per cent from other local sources

Extension funds were used in 1946 as follows 3 4 per cent on administration 1 4 per cent on publications of bulletins and circulars 17 8 per cent on specialist work 47 2 per cent on county agent work 24 0 per cent on home demonstration agent work and 6 1 per cent on 4 H Club work

Federal Appropriations The methods of determining allotments of Federal funds to the various States for extension work vary with specific provisions made in the several acts of the U S Congress The allotments to the States are made on the basis of (a) specified amounts for each State (b) rural population, and (c) farm population

States Appropriations Most of the States legislatures appropiate funds for extension work biennially for the succeeding two year period Requests for extension funds are submitted as separate items in an integrated budget request for all divisions of the land grant colleges—teaching research and extension

County Appropriations County appropriations are made by local (county) bodies on annual basis and are usually ear marked for specific work projects on the basis of local needs

---

*the membership pledge is:

"I pledge my *head* to clearer thinking,
I pledge my *heart* to greater loyalty,
I pledge my *hands* to larger service, and
I pledge my *health* to better living, for my club, my community and my country".

ORGANIZATION

Agricultural extension work in the United States is under the charge of the Extension Service, an agency under the U S Department of Agriculture Extension Service is headed by a Director, who is responsible to the U S Secretary of Agriculture

Since extension activities deal with work among farm and rural communities, the organization at the Federal headquarters is concerned primarily to aid in the evolution of suitable programs of extension work, evaluation of the results obtained, co ordination of States and local activities where necessary and to exert an over all supervisory function At the headquarters at Washington, D C, the Extension Service has the following divisions —

- Division of Business Administration,
- Division of Extension Information,
- Division of Extension Studies and Training,
- Division of Subject Matter
- Division of Agricultural Economics,
- Division of Field Co ordination

Organization at State Level Administration Each State has an Extension Director, jointly responsible to the President of the and grant college of agriculture and the Director of Extension Service of the U S Department of Agriculture The State Extension Director administers all extension funds, is responsible for all extension projects and programs of work within his State

Supervision Located at the land-grant college also is a staff of State wide extension workers including Supervisors and State Extension Leaders who represent the State Director of Extension in dealing with county agricultural agents, county home demonstration agents and 4 H Club agents, and assist in organizing county work

Subject Matter Subject-matter Extension Specialists located also at the land grant college of the State serve as contact officers between the research workers of the agricultural college and the county extension personne incorporating the latest knowledge in their respective subjects into the county extension programs

Organization at County Level The county extension personnel are representatives of the land-grant and the U S Department of Agriculture and are jointly responsible to these agencies Stations at headquarters are ordinarily a County Agent, a County Home Demonstration Agent and a county 4 H Club Agent They work as public officials and are directly in charge of the respective branch of the extension program of the county

TECHNICAL ASSISTANCE TO UNDER-DEVELOPED COUNTRIES*

A few months ago the problem of underdeveloped countries loomed large at a Conference on the Utilisation of World's Resources at Lake Success The delegates to that Conference were told that the population of the world had increased by 1,000 million in 4 generations, and the forecasts are that by the end of the century it would be increased by another 1,000 million It is in this context of a rapidly increasing and not a static population that the problems of better living have to be tackled

In the more advanced countries, where knowledge of modern science and technology has been applied to resource development, production of the necessities of life has grown much faster than the increase in population, and men have been assured freedom from hunger from the cradle to the grave and also a reasonable expectation of freedom from want as a reward of normal work, where such knowledge has been little utilized for the enrichment of human life, as in the case of under developed countries, the standard of living for the common man has remained stationary and even gone down There men have to live even now in constant fear of untimely death by hunger and disease For example in India, about 75% of the people live as medieval peasants often in a family of five rarely cultivating more than 3 acres of land The average per capita income is no more than 36 dollars a year with its inevitable incidence of malnutrition, famine, disease and ignorance

The seven hundred and fifty delegates and observers from many lands who attended the U N O Conference and surveyed the world's resources in food, water, power, fuel, and other essential raw materials were not daunted by these facts and came to the conclusion that there was every prospect of guaranteeing an abundant life to every man and woman, if these resources were integrated and developed with vision and enterprises, on the basis of maximum production and maximum utilization of existing knowledge There is, in fact, no real reason to be pessimistic in our outlook of the future

They were, however, very conscious of the great gap that existed between what could be done and what was being done, and could only hope that by the united efforts of men of good will, public opinion all the world over will be enlightened and this gap would be bridged at an early date It is not the business of the Unesco to prepare project reports or detailed plans for the development of the resources of the under-developed countries, that is the business of Governments of those countries or of the U N O. But it is the special responsibility of the Unesco to spread far and wide the know-how for developing such resources and to focus world's attention on the problem as to how to remove all obstacles that stand in the way of the application of such knowledge. Knowledge often remains imprisoned in secret documents or buried in printed literature, there are often vested interests which would even prevent its use for economic progress. It is the business of the Unesco to make knowledge visible in action or as the leader of the British delegation stated the other day, allay thoughts with the doing of things. The Mayor of New York in welcoming us said that the store of scientific and practical knowledge was itself the world's greatest resource. It is a resource that grows with use and enlarged by sharing. It is the special task of Unesco to make possible such sharing of knowledge.

---

*Based on a speech by Dr J C Ghosh at the Unesco Conference in Paris on "Technical Assistance to Under-developed countries" held in autumn, 1949

How can this be done ? First and foremost, by providing able teachers of technology to institutions in under developed countries. A vigorous search should be made for such men who would take up these responsible positions as a vocation and not as a career. May be there are among the rank of technologists, men of ability, who feel that science must have a moral basis in order to prevent the unlimited power which it offers to man from annihilating himself. May be, there are men of science who feel such anguish in their souls because of evil use of science, that they interpret their duties in terms of humanity as a whole —who feel that they may bring peace to this world by fighting the evils of hunger and ignorance wherever they occur, howsoever remote from their own homes. In my recent travel in middle Europe, I have come across many technologists of high ability who have been uprooted from their homes or who wish to settle down in a new congenial environment, because of unsettled and extremely hard conditions in their own countries. Many of them have sought help from the International Refugee Organization. I am glad that the Secretary of that organization is here with us to day and I would request him to give us fuller information about the possibility of engaging such refugee technologists in useful work in under-developed countries. If men of real talent and high purpose can be discovered in sufficient numbers and given the fullest facilities to teach the nationals of backward countries how they can also develop their resources the paradox of rich countries inhabited by poor people can be solved at no distant future.

The facilities that they would require in order to be effective teachers are abundant supplies of cheap books in science and technology and adequate laboratory and pilot plant equipment. It is difficult to make suggestions off hand how this could be quickly done. Publications of cheap editions of standard books on science and technology say, on the model of Tauchnitz Editions which were so popular in Germany—under the auspices of the Unesco for exclusive use in under developed countries will be a great boon to their poor students. It is desirable that a small section of the Unesco Secretariat should prepare detailed plans for quickly achieving this end.

Next in importance, comes the provision of fellowships which will enable talented young man from backward areas to receive advanced specialized training in foreign institutions which enjoy high reputations as seats of such learning. But it is not enough to acquire such theoretical knowledge from academic institutions. In order to be successful one must learn technology as a science, and also practice it as an art, must acquire the skill for the making of things which are the products of a modern industrial system. Such skill can be acquired in the industry itself and to day the enlightened management of many industries do not hesitate to train their young nationals fresh from a technical college in such skills. But if the student is a foreigner, the doors of such practical training is rarely opened to him. To open such doors will not be an easy task. History shows that interdependence follows industrialization—that a country in the course of its industrial development becomes continously the better customer of another country which is ahead of it. This lesson of history must be brought home to industrial magnates who are not accustomed to look at things from such a long range view point. There is no reason why a determined effort by Unesco should not be crowned with success.

We are thankful that in these International Conferences, the countries that did not matter much before are being given greater attention , that the UNO and Unesco are seized with the determination to give these countries such technical assistance as would quickly enrich the life of their people. The funds provided in the budget however are not commensurate with the great task that is being undertaken. I do feel however, that is the beginning of good work. I agree with the British delegation that more money does not always mean more effective work. A bird may refuse to sing in big cage. But if experience shows as we hope it will, that limited funds have been used for effective work, then I believe, lack of funds will not stand in the way of the wider application of such effective work.

But however generous may be the help that comes from outside, the real progress of a country must come from within. The leader of the Burmese delegation referred to the saying of Lord Buddha— work out your own salvation. This is true not only in the spiritual world but also in the material world. After all the worth of a State is the collective worth of the citizens of the country who constitute the State.

Men in high places are not wanting who emphasize the right of primitive communities to live in their own ways. Scholars in the lands of old civilizations, who have inherited the traditional wisdom of their ancestors, are reluctant that the faith of their people in such ancient wisdom should be shaken. They generally do not recognize that science is something more than mere discovery of the facts and forces of nature, and the principles and laws which correlate them. I maintain, that to its votaries science also is a method, a confidence and a faith. It is a method of controlled observations and experiments recorded with absolute honesty It is a confidence that truth can be discovered It is a faith that truth is worth discovering It is the essence of the whole process of discovering truth that new crucial experiments should be continuously performed and new facts continuously gathered and that men of science should always maintain complete intellectual honesty and re examine the existing views in the light of new facts In a world swayed by passions scientific attitude stands for suspension of judgement until evidence has been properly weighed The contribution which this aspect of science can make to the solution of human problem has often been overlooked It is high time that every effort is made to propagate this cultural mission of science all the world over specially among people of the older civilization

Again for under developed countries if science and technology were to play their part in promoting human welfare considerable change in the outlook of life may be necessary For example it will not do if people there continue to believe that the world of today is the degenerated product of a golden age of an earlier period It will not do if they decry pursuit of happiness in this world for the sake of securing happiness in Heaven It will not do if they harbour mental inertia under the guise of conservation of old ideas It will not do if they say that children are the gifts of God and are welcome in any number Rather should man in those lands learn and feel that he can be master of his own environment that he need not be the victim of fate or of the forces of nature supposed to be subject only to the will of the Gods The Director General of the Unesco in his opening address referred to the famous saying— I believe in the future because I make it He and the Unesco will have done their jobs very well to the old countries if they could inspire their people with faith in the fertility of free will and self decision The transformation of helpless masses of men submissive by long tradition to the vagaries of so called fate into self reliant communities of people who are conscious that they are masters of their destiny is an achievement worth struggling for We, who represent under developed countries in the conference on our part promise all assistance and wish Unesco success in this struggle

---

THE SOIL AND THE ENGINEER

B CHATTERJEE

BENGAL ENGINEERING COLLEGE HOWRAH

THE soil is the oldest and perhaps the most used of engineering materials It is the upper weathering layer of the solid earth crust It is never in a state of equilibrium and is changing from one state to another with consequent changes in its properties due to physical chemical and biological processes operating on the mass The engineer is primarily interested in the physical mechanical and structural properties of soils The size and arrangement of different particles and their behaviour under load with variations with moisture content temperature and air supply are of particular interest to him It is imperative therefore that he should be well acquainted with these properties of soils so that he will be in a position to apply successfully the acquired knowledge to engineering problems

Important contributions in this field have emanated from the geologist the soil scientist the industrial chemist, the highway engineer and the structural engineer From systematic examinations of soils in the laboratory and fields they have furnished valuable information on the mechanical and physical properties of soils in relation to their suitability for practical purposes This has resulted in our knowledge being crystallized into definite form and tests of an engineering nature are now available for comparing the relative merits of different soils

The important physical and mechanical characteristics which control the behaviour of a soil are Internal Friction, Cohesion, Compressibility, Elasticity, and Capillarity The engineer must be in a position to recognize the effect of the above characteristics on a soil and whether these are primarily due to the structure of the soil to the constituents or to field conditions, on the basis of information gained from a number of tests For engineering work tests are performed on both *disturbed* as also on *undisturbed* samples When information is required on foundation for dams bridges buildings etc undisturbed samples should preferably be used but for earth dams fills or highway subgrades disturbed samples give satisfactory data

SELECTION OF SITE AND METHODS OF TAKING SAMPLE

The selection of the site for taking samples for routine tests is also of importance For purposes of making a preliminary survey and selection of site, penetration test with a probing rod such as Mackintosh one man bore hole outfit is extremely useful It can be quickly assembled and exploration to a depth of 50ft performed in less than an hour Once the site is located the most satisfactory method for the examination of the soil strata conditions is by sinking a trial pit The various strata can be studied in their normal state and the ground water conditions exactly determined A record of examination must be made at the actual time of excavation of the trial pit, as the conditions of the soil change on exposure to the air or on contact with water

Disturbed samples from the chosen site are often obtained by shovelling the soil directly into a sack or [illegible]. Soil augers are used for greater depths when only a small quantity of the soil is required for exploration or routine work. When large samples are required, pits are sunk.

Many ingenious methods have been devised for collecting *undisturbed samples*. The apparatus most suitable for this purpose consists of a cutting edge slightly smaller in diameter than the interior of the retaining cylinder about 5" in diameter and 2 0" long The adapter head is provided with a reducer to 1—1/2" boring rods and a non return valve for retaining the sample After sampling, the cutting nose and the head can be removed and end caps fitted in place which prevents drying out of the sample during transport The samples may also be sent to the laboratory in water tight containers The undisturbed samples are kept in a special humid room until actually ready for testing For taking undisturbed samples of granular material at shallow depths, steel boxes about 12" on a side are used. With the top removed, the box is inverted over the soil and carefully forced into it while excavating around the edge by any suitable device When the container is full, the sample is cut from the original material, the box is turned right and the top is replaced

SOIL TESTS

In interpreting the results of soil tests, the conditions of the soil in the field, its formations, history, location and natural environment are taken into consideration as all these factors contribute to the performance of a soil as an engineering material The tests which furnish many of the important soil constants and serve to indicate the presence of constituents having dominant influence upon engineering practices, are detailed in the following table The types of samples to be used as also the information gained on particular properties are also indicated

TABLE 1

	Test	*Type of samples*	*Properties*
1	Moisture Content	Disturbed samples from original location without stones & gravels	Adsorption capacity Capillarity, drainage conditions, etc
2	Specific Gravity	" " "	Void ratio porosity moisture content
3	Apparent Sp Gravity	Undisturbed samples from the original location.	" "
4.	Mechanical Analysis	Disturbed sample material passing sieve No 10; stones and gravels removed and weighed	Grading (relative proportion of sands, silts and clays)
5.	Liquid Limit	Disturbed samples, materials passing through sieve No 40	Capillary capacity
6.	Plasticity Index	" " "	Cohesion.
7.	Centrifuge Moisture Equivalent	" " "	Combined effect of Compressibility, capillarity, and permeability.
8	Shrinkage Limit	Disturbed samples, materials passing through sieve No 40	Combined effect of cohesion and resistance to consolidation
9	Field Moisture Equivalent	" " "	Combined effect of capillarity and cohesion
10	Volumetric and Linear Shrinkages	" " "	Combined effect of capillarity cohesion and resistance to consolidation
11	Electrochemical Analysis	" " "	Adsorption and base exchange properties
12	Chemical Analysis	Disturbed sample materials passing sieve No 10	Absence or otherwise of deleterious materials
13	Maximum Density*	" "	Consolidation and optimum moisture content
14	Shear*	Undisturbed samples, on materials without stones and gravels	Combined effect of internal friction and cohesion
15	Consolidation*	Undisturbed saturated samples	Compression of saturated strata
16	Permeability*	Undisturbed samples for soils in natural state or compacted soil for fill and embankment materials	Grading pore size distribution presence of impermeable strata.

---

*Required in special cases

TESTS HELP IN SOIL CLASSIFICATION

Limited space does not allow me to deal with the procedures for various tests It is, however of interest to describe as to how the results of soil tests have helped in the classification of soils for engineering purposes Soils have been classified into eight groups based upon the presence of soil constituents physical properties and performance These are

A—1 Excellent binder, contains proper proportion of coarse and fine material, high internal friction, high cohesion, absence of detrimental shrinkage, expansion, capillarity or elasticity.

A—2 Improper grading or inferior binding, may be stable in dry weather and soft in wet weather (plastic type) or highly stable when moist but becomes loose and dusty in dry weather (friable type)

A—3 Almost pure sand high internal friction, no cohesion, no detrimental capillarity or elasticity, flows under wheel loads but furnishes excellent support when loads are distributed

A—4, Predominance of silt, internal friction variable, practically no cohesion, no elasticity, may form stable road when dry but will soften in wet weather

A—5 Predominance of silt but with highly elastic properties even when dry, will not retain compacted density but will rebound on removal of load

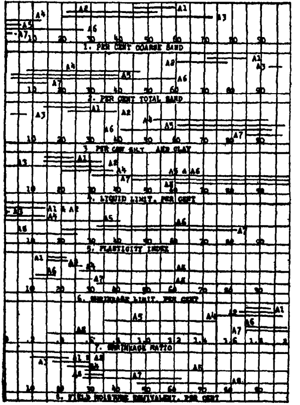
A—6 Predominance of clay, low internal friction, no elasticity, high expansion and shrinkage properties; can be compacted to permanent density, often interferes with macadam bond, deformation occurs slowly under load and very little rebound on the removal of load.

A—7: Similar to group A—6 excepting that it is elastic at certain moisture contents; may have considerable volume change and cause concrete pavements to crack.

A—8: Contains very large amounts of peat or muck; no internal friction; low cohesion; high capillarity and elasticity; will settle under load.

In laboratory examinations. the percentage of each soil fraction *i.e.*, grading, is first determined. Then such tests, as liquid limit, plasticity index, shrinkage limit, shrinkage ratio, field moisture equivalent, etc., are performed. The range of the numerical values of these physical constants for the above eight groups have been shown in the following chart:

SOIL IDENTIFICATION CHART.



Roads and Streets, vol. 81 no. 3, Mar. 1938

A soils belongs to *A*—1 group if this is indicated in every chart. If both *A*—1 and *A*—2 are indicated although neither is indicated by every chart, the soil should be classed as *A*-2; and so on.

SELECTION OF SOILS AS ENGINEERING MATERIAL

The next point of interest is to see as to how the classification of soils into groups has helped in the selection of soils as engineering material and in suggesting soil amendments in specific cases. This point has been discussed under the following three heads:

Soil for Footings, Abutments and Embankments: An examination of the properties of the different groups of soils indicates that the soils belonging to *A*-1 to *A*-4 groups are best suited for foundation work. Next come the less plastic varieties of the *A*-6 and *A*-7 groups. It is important to note that soils of the *A*-5, *A*-8, and the more plastic varieties of the *A*-6 and *A*-7 groups should never be used without special treatment (discussed under treatment of soils for highway and airport construction).

Soil for Fill and Dam Materials: Soils of the *A*-1 to *A*-3 groups and the better varieties of *A*-4 are suitable for use as fil materials either in rolling or hydraulic method of construction. Moderately plastic varieties of *A*-4, *A*-6, and *A*-7 groups can be used for this purpose after stabilization by densification. If possible, soils of the *A*-5 and *A*-8 groups and the more plastic varieties of the *A*-4, *A*-6 and *A*-7 groups should not be used in fill construction. If unavoidable, they must be adequately densified as per specification laid down by soil tests.

In earth-dam construction, groups *A*-1, *A*-2(plastic), *A*-4 (plastic) and the better varieties of *A*-6 and *A*-7 are quite suitable. Friable *A*-2 and *A*-4 can be used in the core-wall. If possible, soils belonging to the *A*-3, *A*-5, and A-8 group and the more plastic varieties of the *A*-6 and *A*-7 classes should not be used in dam construction. When soils of undesirable qualities are used' the densification method of construction should be used or recourse should be taken to compact the soils by rolling or placement by the hydraulic method.

Soil for Highway and Airport Construction: The soils to be used for these purposes need special attention due to the live loads usually exceeding considerably dead loads. Even soils of *A*-1 group need some treatment. The requirements of soils of different groups have been ably summarized by Hogentogler[3]. These are as follows:

A-1: Drainage when ground water level is high; treatment with deliquescent chemicals for stabilised soil roads.

A-2 (*friable*): Moist condition for use as stabilized road material, bituminous surface treatment for use as base course; thin wearing course in pavement; *A*-2 (*plastic*): Drainage to prevent softening of binder from below; treatment with deliquescent chemicals; dry condition for use as base for thin wearing courses.

A-3: Subgrade treatment by admixture of binder or light tars and substantial wearing courses in the absence of binder treatment, thick non-rigid or thin rigid courses.

A-4: *When drainage possible*, thick macadam or concrete pavement of medium thickness; subgrade treatment by admixture with coarse constituents; oiling improves quality. *When drainage not possible*, thick concrete pavement, crack control and reinforcement

A 5 Same as *A*-4, wet conditions worse

A 6 *When homogeneous* thick macadam or rigid pavement for ample load distribution surface treatment by oiling and screening crack control *Permeable but drainage possible* macadam or rigid type, mechanical treatment under traffic increases stability *Permeable but drainage not possible* very strong macadam or rigid type with crack control reinforcement subgrade treatment by admixture of coarse material

A 7 Same as *A* 6 homogeneous in addition surface treatment by means of tar paper for preventing expansion beneath fresh concrete

A 8 Ample crack control and reinforcement for pavement

In conclusion it may be safely said that any engineering enterprise employing soil should be preceded by an elaborate testing of the soil in question because the construction is either made with the *soil* or the structure is built on it It is therefore needless to emphasize that any institution where Civil Engineering is included in the curriculum of studies should have a well equipped soil research laboratory

References

Hogentogler C A Engineering Properties of Soils McGraw Hill Book Company 1937

PAPER MAKING IN INDIA

D C TAPADAR
INDIA PAPER PULP CO, NAIHATI BENGAL

History

THE ancient Hindus used palm leaves *Bhurja patra* and Sachipat (barks of Himalyan Silver Birch and Agaru) for writing The paper was introduced by the Chinese in the early Hindu period or perhaps still earlier The cultural relation which is as old as the history of the two countries took shape in the interchange of ideas arts and sciences The art of paper making was well established in the border provinces of India before it spread to Arabia and Turkistan At Nowshera near Srinagar (Kashmir) the industry is said to be of at least 1300 year old[1] Some of the samples of Nepalese paper collected by the Industrial Section of the Indian Museum are still in excellent condition after about 1000 years of their manufacture There are some samples collected from Manipore and are supposed to have been made several centuries ago The secret of the art appears to have been kept within the sphere of limited communities Its growth at any rate must have been very slow and it was only in the Mohammedan period that it developed into an industry In the middle of the fifteenth century Zainul Abedin brought into Kashmir some experts from Samarkand who introduced an improved technique of softening and beating rags hemp and cotton waste into pulp sizing paper with rice starch and polishing with agate A sort of standardization of the process was thus set up and the quality of the paper so made has been maintained there ever since The Kagzis a class of Mohamedans engaged in the trade spread the industry throughout the country New raw materials like jute barks of trees leaves of date palm were gradually intoduced and the process of manufature was modified accordingly At the time, of the introduction of the modern paper making process, the industry was more or less established in Bengal the United Provinces Madras Trichinopoly and Cochin Sind and other places The quality of paper ranged from ordinary Tulat to fairly strong writing papers for account book and strong wrapping papers The name Bally paper' attached to a class of cheap writing paper of brown to reddish brown colour perhaps originated with the mill made paper of a similar quality produced by the Bally mills in order to distinguish it from the hand made paper of the Kagzis

In 1812 William Carey engaged a few native paper makers to make paper in their own way Gradually the process was modernised and it was in this mill at Serampore Bengal that the first steam engine erected in India was installed in 18-0 for operating the beating engine The first Fourdrinier type continuous making machine was also introduced here in 1832 But owing mainly to lack of support if not definite discouragement on the part of the then Government the mill was not a success and the machine was eventually trasferred to Bally The Royal Paper Mills at Bally was started in 1867 and was run on a commercial scale for a number of years and finally absorbed by the Titaghur Paper Mills in 1905 The Upper India Couper Paper Mills the third of the series of modern paper mills was started at Lucknow in 1879 and is now the oldest of the existing mills in this country In 1913 there were in all seven mills producing 24 000--5,000 tons of paper from Sabai grass rags hemp jute and imported spruce wood pulp ~~In this year~~ R S Pearson of the Forest Research Institute, Dehra Dun published a comprehensive report on the avilability and utilization of bamboo for the manufacture of paper but the process of boiling with caustic soda suggested by him could be applied to bamboo only if the knots were excluded from the charge The first paper mill designed to work entirely on bamboo and using the entire stem was started at Naihati in 1918. The process, based on cooking the material with a solution of magnesium bi-sulphite and modified in details, is now one of the most efficient method of pulping bamboo. The Pearson process was also modified by William Raitt by way of cooking in stages and was soon adopted by the Titaghur Paper Mills, followed by various others. There are at present about twenty mills with a total rated capacity of 1,00,000 tons per annum.

RAW MATERIALS

Paper is composed chiefly of plant fibres collected and formed into a sheet from a watery suspension. The quality of the paper is determined by the nature of the fibres. The method of treatment and the finish and its durability depends mainly on the degree of purity of the fibres i.e. the extent of isolation from the non-cellulosic substance. Cellulose may be defined as the structural basis of plants. Chemically, it is a carbohydrate of a very high molecular weight being composed of a large number of anhydro-dextrose units arranged end to end to form a sort of chain structure. The degree of resistance to chemicals is a function of this chain length, or the degree of polymerisation. The lower forms of cellulose which are soluble in mild acids and alkalis are called hemicellulose. A portion of hemicellulose yield pentose sugars on hydrolysis and is called pentosan. The celluloses and hemicelluloses are held in position by a sort of cementing substance called lignin which is insoluble in water, acids and dilute alkalis but are soluble in strong alkalis and sulphurous acid, sulphites, chlorine and hypochlorites. Besides these there are starches, gum, sugar, resins, fats, waxes, colouring matter and mineral matters in various proportions. The main constituents of some of the more important fibre yielding materials are as shown in Table I. For fine papers like bank, bond, ledger etc. the fibre should be long, strong, light in colour and durable. The length and the structure are characteristics of the parent substance but the colour and the durability depend, as has already been explained, on the purity of the isolated fibres. Generally the substances containing high percentages of cellulose yield fibres of good quality. As the proportions of non-cellulosic matters increase, the method of isolation of celluloses also becomes more and more complex and often the product is degraded due to the fragmentation of the cellulose chains and other chemical changes. For cheap news print and boards on the other hand any fibrous raw material is good enough if it can be converted into pulp at a reasonably low cost. Between these two extreme types there are various grades of paper and the choice of the raw materials is determined by the suitability and the cost of conversion to pulp. The raw material if suitable otherwise, should be available in sufficient quantities and at a reasonable price, in other words it should have little value or should be available in such quantities that the requirements for a paper mill may not interfere with the local demand and prices.

TABLE I

COMPOSITION OF FIBROUS RAW MATERIALS

Material	Cellulose %	Lignin %	Pentosans%
Cotton	91.2	—	—
Hemp	79.3	5.2	5.5
Sisal	77.0	6.00	13.00
Bamboo	50.0	25.0	15.0
Sabi grass	46.0	5.5	12.0
Barley Straw	48.6	16.4	31.9
Oats	43.8	18.6	22.8
Rice	45.5	10.9	21.5
Wheat	56.7	16.3	28.4
Rye	36.3	11.3	20.4
Flax	82.0	2.7	2.0
Ramie	85.0	1.0	2.0
Jute	64.0	21.0	15.0
Spruce	57.44	28.29	11.3
Pine	54.25	26.35	11.02
Beech	53.46	22.46	24.86
Birch	45.30	19.56	27.07
Poplar	47.11	18.24	23.75

MANUFACTURE OF PAPER PULP

Pulping processes can be broadly divided into two classes—mechanical and chemical. The mechanical process consists in grinding the fibrous material with water to a soft workable pulp. The fibres so obtained are weak, impure and subject to rapid deterioration and are suitable only for low grade papers and boards. The mechanical pulp retains about 80% of the raw material and is the cheapest of all commercial pulp. Soft woods of fairly light colour and low resin content are best suited for making news print. If before grinding the logs of wood are softened with steam for a few hours at a pressure of about 45 pounds per sq. inch a more flexible, strong and durable fibre can be obtained which although dark in colour is suitable for wrappers and leather boards. The colour can be improved by washing the steamed logs with hot water containing up to 2% of oxalic acid on the weight of the wood. Such and other processes in which the raw materials are reduced to suitable sizes by chipping or crushing and then subjected to a chemical treatment so as to remove a portion of the cementing substances and then ground or otherwise disintegrated to pulp are called semi-chemical processes.

The chemical pulp is obtained by gradual elimination of the non-cellulosic materials and the process usually involves a series of mechanical and chemical treatments. The yield of fibre is low, the process is complicated and costly but the fibre is stronger and more durable and hence better suited for fine papers than the corresponding mechanical pulp from the same type of raw materials. The impurities of fibrous materials can be removed by boiling with a caustic soda solution of suitable strength and under a moderately high pressure. As the proportion of the impurities increases, the strength of the solution, the percentage of caustic soda, the boiling pressure and the cooking time are all increased proportionately. The caustic soda is largely reclaimed from the spent liquor and re-used in the process. After the digestion is over the liquor is collected together with one or more washes and concentrated to a fairly thick consistency The concentrated liquor usually contains sufficient organic materials to support its own combustion in a suitably designed furnace whereby soda ash or a crude carbonate of soda is obtained This is dissolved in water and the green liquor so obtained is then causticised with lime so as to convert the carbonate of soda into hydroxide and thus the white liquor after causticising is a solution of caustic soda ready for use once more in the cooking process Any loss of caustic soda in the process is made up with an equivalent quantity of fresh soda ash added to the green liquor At high temperatures and pressures a strong solution of caustic soda can dissolve a considerable portion of the isolated fibres especially the lower forms of cellulose and consequently the quality and the yield of commercial soda pulp is often adversely affected

By a partial replacement of the caustic soda with an equivalent amount of sodium sulphide the concentration of the active alkali can be kept sufficiently low the rest remaining in reserve to make up the loss due to the combination with pectin and lignin as the cooking proceeds In practice a calculated quantity of sodium sulphate is added to the concentrated spent liquor before burning the sulphate is thereby reduced to the sulphide and acts as the buffer in the finished white liquor The loss of chemicals incurred in the boiling and washing of the raw materials may be partially or wholly made up with sodium sulphate and this modified process is called the sulphate process to differentiate it from the straight soda process The sulphate pulp is generally stronger than the corresponding soda pulp and the yield is also higher

The general principle of the alkaline cooking process as outlined above can be applied to all plant substances and with proper adjustments of the cooking conditions vegetable fibres can be isolated in grades of strength and purity suitable for a variety of purposes Cotton flax hemp jute deciduous wood grasses straws bamboo reeds and various type of agricultural wastes are reduced to pulp by this process The sulphate process is applied to coniferous wood also Some varieties of specially made sulphate pulps are very strong and durable and are called Kraft pulp

The action of sulphurous acid on lignin to form lignosulphonic acid is the basis of another very important pulping process called the acid or the sulphite process In practice the sulphurous acid is used in conjunction with a certain proportion of suitable base so as to neutralise a portion of the lignosulphonic acid formed during the process of delignification otherwise under the condition of high temperature pressure and concentration existing in the digesters the fibre is weakened due to hydrolysis and is often so hard and deeply coloured that it becomes unbleachable and practically useless Resins are unaffected by the sulphite liquor and always appear in the pulp in a higher concentration than in the raw material Subject only to these limitations the sulphite process is applicable to any type of wood or other plants but it is mianly used for pulping coniferous wood

The comparative figures for the requirements of the fibrous and non fibrous raw materials required for making pulp by the more important commercial processes are given in the Table II

TABLE II

RAW MATERIALS FOR PAPER PULP

	Mechanical	*Sulphite*	*Soda*	*Sulphate*
Wood	1—1 25 Tons	2 25 Tons	1 5—2 0 Tons	1 5—2 0 Toans
Bamboo Grass Straw	—	2 25—3 0 Tons	2 5—3 0 Tons	2 5—3 0 Tons
Lime	—	150—250 lbs	500—600 lbs	300 400 lbs
Sulphur	—	190—300 lbs.	—	—
Soda Ash	—	—	250 lbs	—
Salt cake	—	—	—	400- -500
Steam	—	5000—6000 lbs	12000—13000 lbs	9000—12000 lbs
Water	gall 40 000—50 000	100 000—150 000	100 000—150 000	100 000—120 000
Electricity	70—100 kw	200—300 kw	200—300 kw	200—300 kw

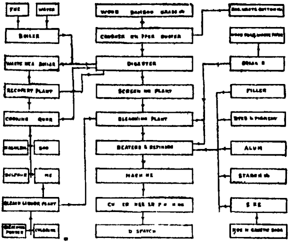
BLEACHING

The raw pulp whether produced by mechanical or chemical process always retains some impurities including lignin colouring matters which are removed or otherwise altered in a fashion so as to cause the pulp to reflect more true white light by a process of treatment technically called Bleaching The chemicals in the process are

(1) Reducing agents like sulphur dioxide sodium sulphite calcium bisulphite zinc hydrosulphite etc which improve the colour of the mechanical pulp by reducing the colouring matter to a white or colourless material the action is not permanent the colour reappears on oxidation or even exposure to light and air

(2) Chlorine or chloride dioxide sodium chlorite calcium hypochlorite and bleaching powder are used for bleaching chemical pulps by way of oxidation and solubilization of the colouring matters which are subsequently removed by washing The effect is more or less permanent depending on the particular process and the extent of bleaching

Various novel processes of bleaching mechanical and semi mechanical pulps have recently been developed so that fibres of very excellent colour and durability are now produced by quite unorthodox methods The principle of chlorination process introduced by Cross & Bevan for isolation of cellulose from plant substances is now widely followed in the manufacture of chemical pulps.



A process devised orininally by De Vain in Holland for pulping straw has been modified by Dr Umberto Pomilio, an Italian chemical engineer for a continuous operation of pulping grasses, straws, bamboo, bagasse etc The removal of lignin and other impurities proceeds in stages and the pulp may be obtained in any state of purity from crude pulp for boards to bleached fibres for fine printings The outstanding advantage of the process is the great saving of steam and the continuity of operation

STOCK PREPARATION

The first step in the preparation of the stock for making paper is to soften or refine the fibres so as to make an uniformly felted sheet when the diluted stock is filtered through a fine wire cloth The simplest way to do so is to pound the pulp with a mortar and pestle or on stones with wooden stampers (*e g* with a *Dheki*) In modern mills handling a large quantity of materials the stuff is treated in specially designed beating engines or refiners The individual fibres are thereby cut macerated and hydrated *i e*, allowed to absorb water on the exposed surface of the fine fibrils By a proper adjustment of conditions the desired characteristics can be developed during the beating process, so that a long fibred stuff can be used for various grades of paper The process of hydration can be greatly enhanced by using external mucilages like starch and cellulose esters instead of disintegrating the fibres into fibrils In fact a certain proportion of lower forms of cellulose is essential for the developement of strength and felting quality of the fibres, the highly purified fibre like alpha pulp, and regenerated celluloses like viscose silk are of little use in paper making Most of the common grades of paper are furnished with a suitable proportion of different kinds of fibre mixed together and refined in the beaters or treated severally and mixed later on in a mixing chest. In writing papers, water-repellant matters like rosin, wax, casein etc are added in the form of emulsion and precipitated back by means of alum, so that the finished paper may take a neat impression of inks on the surface without getting wet through Starch, sodium silicate and various other chemicals are also added to impart special qualities like rattle, handle etc A suitable proportion of mineral fillers like china clay is also added in common grades of writing and printing papers in order to render the texture close, flat and the surface smooth and even These auxilliary materials as well as the dyes are usually added in the beater and throughly mixed with the pulp

PAPER MAKING

The stock so prepared goes next to the machine where it is uniformly spread on the machine wire at a suitable dilution, and a sheet of paper is formed after gradual abstraction of water The machine wire is an endless band of wiremesh spread flat on the supporting table rolls in Fordrinier type of machine or round the circumference of a skeleton cylinder drum in a cylinder machine Water is drained out through the wire assisted in the process by the capillary action of the supporting rolls as well as the suction applied by means of suitably designed vacuum boxes placed underneath The process of conversion of the stock to paper on the machine wire and the subsequent pressing drying, calendering and reeling are all continuous The paper after leaving the press section is dried over a number of steam heated cylinders arranged in two tiers and passed through two or three stacks of chilled cast iron rolls whereby the surface of the sheet is calendered smooth The paper is then removed in the form of reels and finally cut to proper sizes in a cutter machine and finished ready for the market

THE PRESENT CONDITION AND THE FUTURE

The chief raw materials used for paper making in India are bamboo and grass Although 85% of Worlds' paper is made from wood its use in this country is very limited, mainly due to the scarcity of the common pulp woods, the minimum requirement for an economic unit producing soda, sulphate sulphite or mechanical pulp being about 20,000 tons on dry basis Some of the softer deciduous woods like Simul (*Salmalia Malabarica*), Pituli (*Trewia Nudiflora*), Gewa (*Excaecaria, Agallcha*), Salai (*Boswellia Serrata*) etc are easily reduceable to pulp by the soda as well as the sulphite process The fibres are short but can still be used as fillers in common grades of paper Paper Mulberry (*Broussoletia Papyrifera*), Pula (*Kydia Calycina*), Chir (*Pinus Longifolia*) Salai etc can be pulped mechanically and used for newsprint with about 30% chemical bamboo pulp or 25% chemical spruce [2,3] The search for a pulp wood among rather unorthodox varieties has resulted in a project for a large news print mill in the C P

Most of the Indian mills were designed and constructed by British firms who had specialised in making paper from rags and grasses, and consequently the choice and the method of pulping raw materials have also been greatly influenced by foreign interest and practice But in reality any pulping process can be modified to suit a particular type of raw material and if one material is found suitable otherwise, the particular method of pulping to be followed is a matter of convenience Sabai grass and bamboo are usually cooked by the modified soda or sulphate process, but in one mill bamboo is pulped very successfully by a modified sulphite process. The cooking conditions in the latter may be controlled so as to widen the range of pulp quality suited for strong wrappers to fine printings When bleached under standard conditions the sulphite bamboo pulp may be purified to answer the requirements of rayon The process can be applied to straw and grasses as well The waste sulphite liquor is an important source of tanning agent lignin plastics green bond, power alcohol, and yeast Moreover at a consistency of 60/70% dry substance, the concentrated sulphite liquor can be easily burnt in a suitably designed furnace and the heat of combustion utilised to raise steam sufficient for the entire process of pulping and concentration and under properly controlled conditions about 50% of the total sulphur and 70% of the magnesia can be recovered from the products of combustion A similar course of experiments on wood has resulted in the erection of a large pulp mill in Canada very recently [4,5] There are several board mills in this country using straw, bagasse and waste paper pulped by very crude processes whereas a modern semi chemical process like the Asplaund would be much more efficient Extensive researches are necessary in the various branches of the pulp and paper industry

The forest resources in India are not inconsiderable but the materials required for paper are scattered and the transport facilities are not adequate and consequently the mills are finding great difficulties in procuring suitable raw materials at reasonable prices The areas rich in bamboo and grass are being exploited without a systematic replacement and thus the source of supplies are gradually receding from the place of manufacture and market The situation has further deteriorated due to the partition, because an additional quantity roughly 40,000 tons, of raw materials are now wanted from the forests in the Indian Union Under these circumstances, the production target fixed by the Paper Panel (2,64,000 tons for 1951 52 and 4,71,000 tons for 1956 57) can hardly be reached by simply erecting more machines The forest resources have to be more systematically surveyed and the search for new raw materials greatly intensified Under favourable conditions bamboo grows faster than wood and the average yield per acre from cultivated forest may be as high as 4 tons against 26-- 3 tons in case of coniferous woods[6]. Pearson described the occurrence, the nature of growth, and the availability of several types of bamboo in Bengal, Bombay and Madras On waste land bamboo may be a profitable crop Some quick growing trees like Sabai, Paper mulberry and Shimul can be cultivated to boost the production of paper pulp Some of these trees can be raised in bamboo plantations with advantage The waste wood from timber works and plywood factories can be converted to pulp for lower grades of paper There are several types of wild grasses and reeds which have not been exploited for paper making Savana grass and Nal reeds (Arundo Donax) yield fibres not much inferior to that from bamboo

An elaborate method of treatment and complicated machineries are out of consideration for small scale industries So the use of bamboo and other fibrous plant is not practicable for making hand made paper, the choice being often limited within cotton and linen rags, waste cotton hemp waste papers and imported wood pulp The bast fibre from paper mulberry may readily augment this list It is extensively used in Japan and Siam In Burma it is also made into card board blackened for use as slates for writing purposes in schools The wood is white and can be pulped by mechanical as well as chemical process The tree grows in various types of soils and spreads by seeds and root suckers out growing other species[7] If the villages are properly instructed and encouraged this plant can be raised in this country and exploited for paper making

Three fundamental needs for the healthy growth of the industry are materials machines and men Materials we have got if not enough more can be grown, machines can be constructed when there is a sufficient demand but technicians and skilled labour have to be raised from amongst ourselves and it is a strong policy of the Government that is wanted to correlate or orient the three Training of the men for the industry should be sufficiently encouraged The courses of studies in technical institutions should include Paper Technology preferably as a separate subject An association of the technical men in this and allied industries should be organised and meeting arranged in important localities whereby the technicians may discuss various problems and share one another's experience and knowledge for the betterment of the industry

REFERENCES

[1] A T Gills, Paper & Print, Spring 1946
[2] Forest Utilization Publication—B 108
[3] Indian Print and Paper—March, 1942
[4] G H Tomlinson and R S Wilcoxson—The Economic Disposal of Waste Sulphite liquor—*Paper Trade Journal*—April 11, 1940
[5] *Paper Trade Journal*—Nov 11, 1948
[6] *Indian Pulp and Paper* —July, 1947
[7] Sylviculture of Indian Trees—Troup.

A METHOD FOR COMPARING THE RELATIVE QUALITY OF JUTE YARNS

K. R. SEN

TECHNOLOGICAL RESEARCH LABORATORIES, INDIAN CENTRAL JUTE COMMITTEE, CALCUTTA

INTRODUCTION

THE Indian Standards Institution has undertaken the task of specifying the standard methods of estimating the testing and performance of the fibre yarn and fabric of jute. There are powerful factors which operate as hurdles in the way of devising easy testing standards in the case of jute fibre. These have already been discussed[1]. It is proposed now to examine the factors which affect the basis of comparing the spinning qualities of different varieties.

The technique at present in vogue for a standard method is a two-pronged one. In the first place a yarn is spun from a jute under constant conditions of draft twist and the mass of roving per unit length. This yarn which thus possesses a specified grist is tested for the breaking load as well as the coefficient of variation of the mass of pieces having a specified short length by a procedure which is fixed[2]. Hence along with the coefficient of variation which is used to indicate the degree of regularity of the yarn the tensile strength or the quality number (or quality ratio) is employed to represent the bases for comparison of the spinning quality. Between these two measures of quality the latter (quality number) is considered as of principal importance for the effect of the former estimation generally *merges into* that of the latter and also shows numerically a much shorter range of variation than the latter. While the quality number expressed as percentage has been known to vary from about 40 to 120 the irregularity coefficient ranges from about 21% to 38.

Usually therefore the yarns from different fibres are compared by their values of the quality number when spun practically to the same grist and twist. In other words it is considered that the relative test values giving the quality numbers of a set of standard yarns indicate the relative spinning quality of the fibres.

As a standard method for start i.e. until sufficient knowledge has been foregathered the method described above seems the only way of solving the problem. However within the last decade or so much scientific information about the physical characters of jute fibre and yarn as well as about the procedure of yarn making have been accumulated. It is now known that when spun from one particular fibre the quality number at one grist may be relatively higher than that of another similar yarn from a different fibre while the relative order of superiority may become *inverted* at another grist. This knowledge has necessarily warranted a revision of the standard method for comparing the spinning quality of different yarns. A scrutiny of the fundamental factors which predominate in subscribing to the quality of a yarn is therefore attempted here.

DISCUSSION ON QUALITY OF JUTE YARN

It has been noted that the qualities of a jute yarn of specified grist (or fineness) with which a spinner is most often concerned are as in the case of any other spun yarn manufacture (*i*) the thread strength and (*ii*) the regularity. The regularity of a yarn depends partly on the characteristics of the fibre such as friction multiplicity and length of each of the adhering filamentous units which compose the material during the different stages of processing and also quite largely on the distribution of the varying individuals before and during processing.

All spun yarns whatever the textile fibre used are more or less irregular consisting of thick and thin places. The irregularity is very high in the case of jute yarn and the smallest in the case of the man made staple fibre. The individuals of staple fibre are more or less uniform in external features so that the effect of distribution is minimum. The variations of thickness are introduced during the drafting operation as a reaction between the fibre characters as distributed in the body of the material under draft and the drafting treatment and the machinery. There is of course no process yet known such as can altogether eliminate this effect particularly in the case of the natural textile fibres. However this may be reduced in the case of jute in two ways

(*i*) by ensuring perfect and complete splitting of the meshy fibre complex into single filamentous units prior to drafting or

(*ii*) by blending suitably matched fibres.

Both these methods have however got very great practical difficulties lying in the way of consummation. Between the two again action (*i*) is more difficult to carry out.

Now, if not for any other reason simply due to the existence of the thick and the thin places a gradient of strength exists along the length of the yarn. The strength of the single thread we measure is actually the strength of the weakest point of the yarn within the specified test length. Variation of the strength of jute yarn with test length has already been studied[3].

So, it is clear that apart from any direct effect on dyeing, finishing etc., the irregularity of jute yarn also affects the strength of a specified yarn. This effect of irregularity in fact merges in the quality number' estimate of the yarn. This fact seems to reduce the items of measurement for quality estimation of jute yarn to merely one variable *viz* the strength of a specified yarn. Now, it is a matter of practical experience that the quality of a material is usually determined by the amount of work done *on it* to effect disintegration or rupture So, the quality of a specified jute yarn should be a function of not merely of its strength (for a specified test length) but also of its extension at the point of break under pull Thus for the study of the quality of a jute yarn under specified conditions of testing, one must consider the grist of the yarn, its breaking strength under tension and the extension at the breaking point These three factors may be reduced to two by considering the tensile, or intrinsic, strength of the yarn specimen This tensile strength expressed as the percentage ratio of the breaking load in pounds to the grist in pounds per spyndle (=14,400 yards), has been nominated the quality ratio or quality number of the yarn

In addition to those two factors which, except for the application of draft, admit of very little personal control, being mainly dependent on the physical properties of the fibre *vis-a vis* the yarn structure, there is another variable factor which can to some extent modify, through the structural medium, either of these two quality determinants of the yarn This variable however, is almost totally under human control It is the "twist" applied to the spun yarn

The published methods so far available regarding the assesment of quality of jute yarn, relyon the measurement of the quality number of the yarn spun with a specified draft and twist from a roving of fixed mass per unit length Such study is only supplemented by measuring irregularity of the yarn as the coefficient of variation of the mass of short pieces of specified length The factor of extension which for the whole range of jute yarn formation, varies from 1% to 3% nearly, is disregarded

On the basis of these considerations, leaving aside the question of irregularity which affects the yarn quality number through its breaking load, and also neglecting the very small effect of extension, it is now proposed to examine the validity of the quality number of a specified yarn as a standard measure for comparing the relative spinning qualities of jute yarns

BASIS OF QUALITY NUMBER OF YARN

There is little doubt now that the quality of a spun (unsized and otherwise unfinished) yarn, is a complex function involving several factors broadly of the two following categories—

(i) physical nature of the material ;

(ii) spinning treatment

The most relevant physical characters of a textile material, known from experience in the sphere of various other fibres to vitally affect yarn quality number are —

(i) the staple length (l),

(ii) the mass per unit length or gravimetric fineness (*m*),

(iii) the frictional resistance (ϕ),

and (iv) the breaking load (p)

In the case of jute, there is one special character which plays no mean part in determining the quality of the yarn spun It is—

(v) the splittability of the meshy complex(μ)

Considering these five physical characters to be the principal 'material' factors for the production of the resulting yarn quality number in the case of jute, it may be understood that these fibre characters act on the quality number through a quantity, B, which is an involved function of l, m, ϕ, p, and μ In other words,

$$B = f(l, m, \phi\ p\ \mu)$$

Now, if yarns are spun from different varieties of jute having different physical qualities of fibre, to a specified grist (G), using a constant draft (D), and a fixed twist (T) from roves of the same mass per unit length (R), the Quality Number, Q_o of each yarn will naturally be a function of its B That is to say—

$$Q_o = M(B) = M_1\ (l,\ m, \phi\ \ p,\ \mu)$$

This is the basis of the present quality number technique of comparing the qualities of yarn from different varieties of jute The practice in vogue is to spin 'standard" yarns under specified spinning conditions from the different jute varieties, find the value of Q_o's for the products, and compare their relative order However, before proceeding to adjudge the value and the width of applicability of this technique it is necessary to scrutinise the function, M_1, the fundamental and dominant element in the study of yarn quality

The Function, M_1

It is definite that so far as jute is concerned, the staple length (l) remains a mystery until the yarn is spun Although the jute strands which ultimately go to form a yarn, are, most of them, not small like cotton or any similar fibre, the length nevertheless has an important function in the determination of yarn quality It was shown[4] how the quality number for the "standard' 10 lb hessian weft yarn, which bears a curvilinear relation with p/m i e , the tensile or intrinsic strength of the fibre concerned, happens to assume a rectilinear form of relationship with lp/m (This is also a clear indication that the strength reducing 'slippage" factor which operates as a result of yarn structure, for a jute yarn spun under constant spinning conditions, is insignificantly small i e , practically "zero', just as for long staple cotton fibres[5])

The importance of '*l*' in the case of the yarn quality of jute, and the fact that '*l*' cannot be known prior to actual spinning of the fibre, make it necessary to find some measureable characters of jute, which should influence the generation of the staple lengths during processing and spinning so strongly, that '*l*' may be replaced in any estimation of yarn quality from fibre characters No doubt much fundamental work is required to be done before such characters, relevant beyond any pale of doubt, can be found However, as a *Working hypothesis*, in absence of requisite knowledge, one may proceed with characters which seem most probable from *a priori* consideration of facts so far known

Thus it seems possible that the splittability, or complexity co efficient, μ, as defined earlier[4], the strength gradient of a filament, $\frac{dp}{d\lambda}$, where λ is the test length corresponding to a filament strength, p, nad the cross-sectional area of the filament, A $(=\pi ab)$, the area being assumed to be elliptical[7] with the semi axes 'a' and 'b' may prove to be such measures The reasons are —The complexity determines the probability of transverse break down of the meshwork of a jute into single filaments as well as into filaments of different degrees of multiplicity, in course of yarn making So, this factor indicates the possibility of longitudinal break down of an element by the drafting force The strength gradient will show up the minimum drafting force necessary to break down a iflament longitudinally, and the cross section will indicate the weakest point within a filament, where such minimum force will be likely to break the filament,and so determine the length of the parts There is of course one definitely known fact in this connection It is that the maximum possible length of a filament in the yarn cannot exceed the "grip to grip' distance (L) between the feed and the delivery rollers So, always, $l<L$

Now from the above discussion, the staple length (l) should possibly be a function of μ, A and $\frac{dp}{d\lambda}$, it may therefore be stated that

$$l = \psi\left(\mu, A, \frac{dp}{d\lambda}\right) < L$$

Since each of these three determining factors may vary independently, 'l' will be determined by any one of these particular factors, while the other two remain constant So, it may be stated that, under such conditions,

$$l \propto \frac{1}{\psi_1(\mu)}, \quad \propto \psi_2(A), \quad \propto \frac{1}{\psi_3\left(\frac{dp}{d\lambda}\right)}$$

Therefore, when all three vary,

$$l = K\ \psi\left[\frac{\psi_2(A)}{\psi_1(\mu)\quad\psi_1\left(\frac{dp}{d\lambda}\right)}\right], \text{ where } K=\text{constant.}$$

This may be put as $l=kz$, 'z' representing the function ψ Evaluation of 'z' is difficult, and requires much ground to be covered before it can be brought under control However, the values of 'μ' and 'A' can be found Also, the values of 'p' for different values of 'λ' can be obtained on small representative samples of a jute Thence, finding the values of Δp for corresponding values of $\Delta\lambda$ the mean value of $\frac{\Delta p}{\Delta\lambda}$ may be used to represent $\frac{dp}{d\lambda}$.

Now, the simplest measure of the function, 'z' which can be conceived, is the linear power of the uninvolved quantities, A and $\frac{\Delta p}{\Delta\lambda}$

On this consideration, an estimate of ψ may be obtained by calculating—

$$\left[\frac{A}{\mu.\frac{\Delta p}{\Delta\lambda}}\right]$$

This quantity may then be statistically correlated with 'l', measured from different qualities of jute yarn spun under the constant conditions considered above, to test the likely *relevancy* of the combination of the three measurable quantities, μ, A and $\frac{\Delta p}{\Delta\lambda}$, in linear power for estimating 'l'

However, the qualities of gravimetric fineness, 'm' and the strength, 'p' of jute filament may be reduced to the single factor of tensile strength, p/m So, the fibre quality function in the estimation of the yarn quality number for the "standard" yarn reduces to one characterised by three factors of more or less an involved nature That is to say,

$$Q_0 = M_1\ (\phi,\ p/m,\ z)$$

Failure of Q in Comparing Yarns of Different Grists

Since, for spinning warp or weft yarn of hessian or sacking, having different grists and twists, the drafts need also be varied even when roves of a constant mass per unit length is employed, for jute yarns of different types, to define the quality number (in which 'G' has merged) the *general equation* of quality becomes a function 'q' involving M_1, D and T In other words,

$$Q=q(M_1,\ D,\ T)$$

The complex effect produced in the quality number of different kinds of yarn of different grists, can be seen from the varied nature of the actual G Q relationship as depicted in Fig 1. In this figure each value is based on 240 to 300 observations The fact that the curve for the different jute varieties are not parallel to one another, clearly indicates that for different jute varieties, the judgement of relative quality based on a simple estimate like Q_0 (as found under constant spinning conditions) is faulty and inadequate. The quality number of a particular jute found by using one particular set of D and T can not give a proportionate quality number at any other value of D and T Extending this conclusion it is easy to see that the relative values of quality number of different jute fibres under one set of spinning conditions cannot be expected to represent the relative values under a different set of those conditions Any standardisation of procedure of estimating yarn quality must, therefore, be done on some other basis than the simple one of estimating Q_0 But before this is taken up for discussion, it is necessary to see to what extent the specified quality standard should be made to depend upon the breaking extension of the jute yarn also This factor was ignored in the earlier discussion

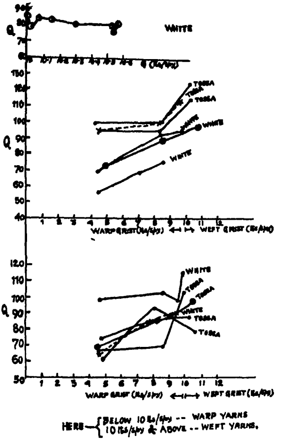


Fig 1

Yarn elongation at break

In so far as the extension of a yarn at break depends on that of the constituent filament, this character of jute yarn may be relegated to the care of the function 'B' (*ante*) by making it more comprehensive But besides fibre properties, yarn extension is also governed by the twist *vis a vis* the grist The graphs in Fig 2, Fig 2*a* and Fig 2*b* give the relative frequency of the breaking extension of yarns possessing different grists and twists, in the case of different varieties of jute The data are based on 300 observations in all cases but one. In this case the observations numbered 258. From the horizontal positions of the curves and their respective dispersion, one is entitled to think that, most probably, the effect of twist on the breaking extension of jute yarn of any moderate grist, is considerably small compared with the effect of fibre quality. The effect of grist is also very slight as the relative horizontal shift, when viewed in Fig 2 vertically, seems to indicate. So it is not expected that any serious fault will be committed if the extension at break which possesses a very small average magnitude also, being

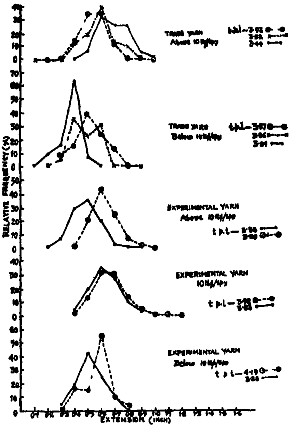


Fig 2

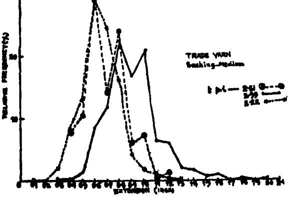


Fig. 2*a*

1% to 3% in the extreme cases for yarns varying in grist from 7 to 52lbs/spy, and in twist from 4 2 to 1 7 t p i is ignored in finding a generalised standard basis of comparing the spinning quality of jute yarns

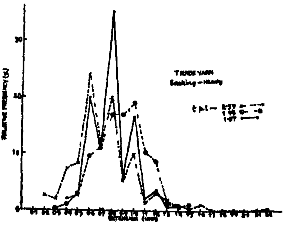


Fig 2b

The standard quality specification may therefore be wholly based on the functional equation—

$$Q=q\,(M_1,\ D,\ T)$$

Generalised Basis of Efficient Quality Specification

If the equation $Q-q(M_1, D, T)$ is further generalised by including as variable the gravimetric fineness of rove (R), which has so far been considered constant, the equation which emerges for consideration here, is

$$Q=q_1(M_1\ D, T, R)$$

There are, in this equation, four independent variables of which D, T and R can in some respects be controlled in processing and spinning So, the right hand expression of the equation can be split up into two parts, one involving only the effect of the fibre characters which cannot be varied, and the other, the effect of the processing and spinning treatments on the structure *vis a vis* the fibre characters, most of which can be varied at will Thus the equation can be written as the sum of two terms, one, a simple function of M_1 and the other an involved function of all the four variables This equation may be written as

$$Q=\alpha\,(M_1)+\beta\,(M_1\ ,\ D,\ T,\ R)$$

Here, β represents the involved function of all the four variables When D, T and R are constant the effect of M_1 as far as this affects yarn quality is indicated by this function

Now, as a matter of *convention* based on the suitable quality number for the yarn of a particular specification of grist and twist, the value of 'R' may be adopted to be such that for particular specified values of 'D' and 'T', yarns of different grists are produced In other words, R D and T can be controlled for particular values of different grists and the yarns thus produced compared against specified quality number Under such circumstances, (i) for different yarns of a particular grist, D, T and R being constant, Q will become practically a function of M_1, just as Q_0 was shown to be , and (ii) for different grists of yarn from the same material, Q will depend on M_1 as well as on the effect of specified values of R, D and T in so far as M_1 reacts to these factors Thus by spinning different fibres to a set of grists under the specified conditions and plotting the data for Q against G, a set of curves variously directed, will be obtained These curves should be expected to intersect the conventional G Q curve which is *practically rectilinear*, for warp or weft, at some point or other The coordinates of the point of intersection (G_1, Q_1) will then represent the immediate data for estimating the standard spinning quality The estimate of relative quality can be based on the single quantity

$$\frac{G_1\times Q_1}{100}$$

which may be nominated the Standard Yarn Measure, or briefly, "SYM" The value of "SYM" will be different for the warp and the weft yarns, for these two different cases two different conventional scales will require to be used The smaller the value of SYM, the finer will be the yarn capable of being spun to produce the desired quality number SYM will give the best measure of the standard yarn quality, and different fibres will be easily comparable as their values will, once for all, lie on different points of the same conventional curve *taking into consideration the variability of Q with G* The defect of the present technique of comparing the quality numbers at one and the same

TABLE I

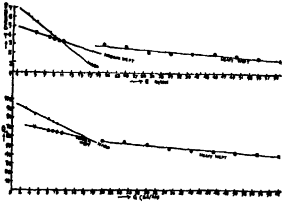
CONVENTIONAL SCALES FOR WARP & WEFT

Yarn type	Grist (lb spy)	T P I	Suitable Quality No Q
Warp—	3	6 3	90
	5	5 5	85
	7	4 7	80 5
	9	3 9	75 5
	11	3 1	71
Weft—			
Light	5	4 3	70
	7	4 0	67
	9	3 7	65
	11	3 35	63
	13	3 05	61
	15	2 75	58 5
	17	2 4	56
	19	2 1	54
Heavy	20	2 1	53
	25	2 1	51
	30	2 0	50
	35	2 0	48
	40	2 0	46
	45	2 0	44
	50	1 9	41 5
	55	1 7	40
	60	1 5	38 5

at one and the same grist is that the variation of quality number with grist is not taken into account

Conventional Scales for Warp and Weft

In fixing the conventional scales due regard has been shown to the bases on which the trade judges the suitability of a fibre for a particular quality The freedom to use any suitable Rove mass per unit length with appropriate Draft has also been recognised and so the scales are given as suitable quality number (Q_s) for corresponding grist (G) and turns per inch (T) The different scales for the warp and the weft yarns are given below, in these the values of Q determine the desirable quality number for the specified spinning conditions



A representation of the conventional graph is given in Fig. 3 which also gives the $G-T$ graphs

The results actually obtained for 'SYM' for warp yarns from various species and varieties of jute are stated in Table II The values of Q_0 i e the quality number for the present standard 10lbs hessian weft yarn, are included in the Table for comparison of the order of quality as obtained by the two methods

TABLE II

ORDER OF QUALITY FOR DIFFERENT FIBRES

Jute Species	Jute Variety	Q	SYM (warp)	Order of superiority
White	I	116	0 66	1
	II	97	5 75	3
	III	94	5 54	2
	IV	74	7 05	4
Tossa	I	114	0 65	1
	II	112	2 28	2
	III	98	8 59	4
	IV	97	5 66	3

The order of superiority by the SYM method differs to some extent from that by the Q_0 method, as one may expect from the discussion above

REFERENCES

[1] K R Sen *ISI Bulletin I* 1949
[2] B K Chakrabarti C R Nodder & K R Sen Techno Circu, Indian Central Jute Committee 1945
[3] K R Sen & C R Nodder Techno Res Mem Indian Central Jute Committee No 9 1945
[4] K R Sen & C R Nodder Techno Res Mem Indian Central Jute Committee No 7 1944
[5] K R Sen *SCIENCE & CULTURE 4* No 5 1938
[6] K R Sen & C R Nodder Techno Res Mem Indian Central Jute Committee No 7 1944
[7] K R Sen *J Text Inst 39* 10 Oct 1948

Notes and News

DAMODAR VALLEY CORPORATION

The Damodar Valley Project came in for sharp criticism during the debate last month on the budget grants for the Ministry of Works, Mines and Power

The criticisms levelled against the Corporation s work were mainly three fold The first referred to the question of the degree of autonomy which should be given to the Corporation and a number of members led by Mr B Das and Mr B Shiva Rao expressed strong view that the Centre should exert far greater control on its work than it had done heretofore Secondly, extravagance in expenditure was hinted by some members who feared that the original estimate of the total cost would go up by nearly 30 percent The third criticism would have it that the Government had given undue importance to foreign engineers and had not made the best possible utilization of the available Indian engineering talent

In reply to the first criticism Mr Gadgil Minister for Works Mines and Power compared the relation between the DVC and the Centre with that existing between National Coal Board and the Ministry of Power and Fuel in the United Kingdom He explained that the Centre could control policy exercise indirect control over financial commitments when the Corporation wanted foreign exchange and give directions if necessary under the provisions of the Bill But the criticism as to what extent this control was exercised was left largely unanswered

The Minister s reply regarding the charge of extravagance was far from reassuring He simply said that he did not think the overhead expenses were too heavy and that if he felt it was the case he would not hesitate to use his powers to reduce such expenses Regarding the fullest possible use of available of Indian engineering talent, the Minister's statement that only two out of the total twelve technical experts employed by the Corporation were foreigners was generally acclaimed What was more important was his disclosure of the unwillingness on the part of certain Indian States to release their senior and experienced engineers for the DVC work and the specific case of the Government of Madras refusing to spare a senior engineer was mentioned Such difficulties are not new, and these only unmistakably show that after all we do not possess any sizeable reserve of top ranking engineers to whom work of the magnitude of the Damodar Valley Project could be entrusted The Minister also revealed that a chief engineer was shortly going to be appointed to the DVC and that efforts were made to secure the services of a qualified engineer from the U S A

WEST BENGAL'S PROGRAMME OF INDUSTRIAL DEVELOPMENT

The West Bengal Assembly have passed Rs 73,78,000 for expenditure in 1950 51 for industrial development The main features of this development include extension of electrical power supply, fish culture and small scale cottage industries The North Calcutta Electricity Scheme planned to cover an area of about 750 sq miles and supply power upto Santipur Nabadwip and Birnagar would cost Rs 24,00 000 Ranaghat, Santipur and other places would receive electricity from June this year and the scheme is expected to be completed by 1952

Silk, sugar and salt featured prominently in the government s programme for small scale and cottage industries for which a sum of Rs 4,00,000 had been provided Up to the end of December last year silk worth Rs 7,06 000 was produced and about Rs 5,00,000 received from the sale of silkgoods The government had undertaken development of this industry on a co operative basis

The Chief Minister reported that one of the sugar mills allotted by the Central Govt to West Bengal would be established at Krishnagore and would start working within a year or so

A survey had been recently made by experts of a French Salt industry at the invitation of the government in the Contai area, Midnapore, according to which about 5 million mds of salt a year could be produced in this area

A sum of Rs 20 89 000 was voted for expenditure under 'fisheries' The State's deficiency in fish was brought out by the Minister for Fisheries, when he said that the total supply of fish from the State itself was only 50,000 tons against the total annual requirement of 4,32,000 tons The government had paid great attention to fish culture and had produced about 2 million fry in their nurseries which were distributed to private pisciculturists The government's estimation was that if half of this fry survived, the fish production would increase by 8000 mds. at the end of three years A Danish expert had been invited to make a survey of the off shore and coastal fishing in the Bay of Bengal area

The production of cinchona received a budgetary allocation of Rs 32,64,000 In moving the demand, the Chief Minister said that the government had about 150,000 lbs of quinine in storage and additional plantations to be developed at Maungpoo would yield about 50,000 lbs of quinine annually

FOREST RESEARCH IN INDIA

The Forest Research Institute, Dehra Dun, is now being reorganised with a view to develop the forests and improved uses of forest products of our country Under the new set up there are some minor administrative changes and that the Utilization Branch has been replaced by 7 independent Branches (See "*Forest Research in India and Burma*, 1946 47, Part I)

The Silvicultural researches include routine experiments as to the methods of stockings, seed testing, investigations relating to trees and crops, soil analysis sample plot calculation, resin tapping etc

The importance or correct identification of timber, their mechanical tests and physical determinations, proper and improved seasoning, best and cheapest methods of preservation, and uses of different timbers for specific purposes are now being gradually realised by consumers and the staff of the various branches of the Forest Research Institute have rendered valuable services to the timber users in this direction

It is pleasing to note the manufacture of modern furniture of laminated construction with decorative veneers at a comparatively cheap rate, and that there are serious attempts to make use of waste veneers, wood shavings and saw dusts as table tops, flooring blocks, electric switch cover etc Interesting observations have also been recorded in connection with impregnated wood and plywood research, production of absorbent cotton, high grade papers, preparation of pulp from various sources, peppermint oil from the Indian strain of *Mentha piperata*, camphor from *Ocimum* sp, pectin from tamarind seeds and resins from various other sources

The mycologists and entomologists are now developing new methods and projects to save our forests and forest products from fungi and insect pests The plant protectors are now exploring the possibilities of collecting information and data on specific tree diseases and host relationships of the parasites and other wood forests in particular areas for employing these information in prevalent Silvicultural practices

The results obtained by the staff of the various departments at the institute and the projects at hand are encouraging

NATIONAL PHYSICAL LABORATORY

One of the subjects on which the NPL, which was opened at New Delhi on January 21, 1950 (See *Science and Culture 15*, 318, 1950), will undertake work is research on fundamental standards of length, mass and time and their derived standards Specialised equipment and precision instruments have been secured from abroad Besides its valuable apparatus for precision work the laboratory will have one of the best equipped libraries in physical science Nearly 10,000 books have been obtained and more are on order A large and well equipped workshop, including glass blowing and optical workshop, photo and drawing offices, a gas house and a cafetaria will be additional features of the laboratory which will also accommodate the laboratories of the Defence Science Organization The laboratory has recently acquired an Electron Microscope which will shortly be installed

The work of the laboratory will be carried out through the following Divisions Weights and Measures, Applied Mechanics and Materials, Heat and Power Optics, Electricity Electronics and Sound, Industrial Physics, Hydraulic Research and Analytical Chemistry The laboratory will also have a Research Information Service

The different section will be in the charge of Dr S Parthasarathy, Mr V Cadambe, Dr S Jnanananda, Dr K N Mathur Mr G D Joglekar and Dr W M Vaidya, *Assistant Directors* Dr K S Krishnan, the eminent Indian physicist is the director of the laboratory

JUBILEE OF NATIONAL PHYSICAL LABORATORY (England)

The National Physical Laboratory, Teddington (England) recently celebrated the jubilee of its foundation on January 1, 1900 when Dr R Glazebrook took up appointment as Director Originally the laboratory was housed in Kew, but shortly afterwards it was moved to its present site at Teddington The staff which in 1900 was about 21, has in course of time increased to its present strength of over 1,100 The laboratory was originally founded for the standardization and verification of instruments, the testing of materials and for the determination of physical constants At the time of the opening of the new building at Teddington in March 1902, the late King George V, then Prince of Wales, had expresed a hope that the laboratory may develop into a national organization for "furtherance of application of science to commerce and industry" This hope has during the last fifty years been more than fulfilled

"The laboratory" according to *Nature* "unlike most of the Government scientific establishments, is organized on the basis of subjects, rather than the service of particular objects"; its different divisions cover most of the fields of physical science, which has enabled it to be the seed-bed in which different researches have germinated and grown until they were sufficiently vigorous to lead a separate existence else where Thus the Building Research Station, the Road Research Laboratory have grown out as separate organizations Similarly research in hydraulics, instituted by the previous Director Sir Charles Darwin, has been transferred to the control of the Hydraulics Research Organization It is only lack of facilities which is delaying the transfer of the radio work of the laboratory to the formal care of the Radio Research Organization This applies also to the transfer of much of the work of the Engineering Division and some of the work of the Metrology Division to the Mechanical Engineering Research Laboratory which is being established at East Kilbride

In addition to its long term research, the Laboratory has fulfilled a very real need in the services which it provides in carrying out special investigations for other Government Departments and industries The special feature of the N P L is considered by *Nature* to be as follows "In many research establishments the needs are determined by higher authority but in an establishment working primarily for the general welfare of all industry and organised by subjects, the needs and problems must, in general be recognized and formulated by the research workers The latter is the case in the National Physical Laboratory which, in this sense therefore, is similar to a university, but it has been able to meet some needs beyond the scope of universities in the past The staff being members of the Scientific Civil Service, have been able to carry on long term research on a more stable basis than in many universities, where the nature of the research can change suddenly with changes of staff. Also, the possession of large scale and expensive equipments, most of which was previously beyond the reach of universities has enabled the Laboratory to work on subjects which universities could not tackle"

NATIONAL CHEMICAL LABORATORY

The various sections of the NCL, Poona which was opened on January 3, 1950, (See *Science and Culture, 15*, 317, 1950) have already started operating and a good deal of research in Indian oils and fats is being done in the Organic Chemistry section under Dr J S Agarwal and 16 scientists Work in the Biochemistry section is in progress under the direction of Dr M Damodaran and 14 scientists Dr J H Truttwin of Sweden has taken charge of the Chemical Engineering section with 10 scientists Dr J Gupta who was on study tour abroad, has recently taken charge of the Inorganic section with 7 scientists, which would deal with research on mineral chemistry The Survey and Intelligence section is in charge of Dr K G Mathur with 8 scientists, and the Administration section dealing with the Standardization and Production of Pure Chemicals is in charge of Dr B D Laroia and 2 scientists. Work in the Plastics and High Polymers and Physical Chemistry under 16 scientists is to be commenced hortly. Dr J. W. McBain is the director of this laboratory (See *Science and Culture*, *14*,419, 1949) Scientific research has not been sufficiently utilized for industrial production in India One of the most important functions of this laboratory will be to bridge this wide gulf In this, all the divisions will play their part in helping to meet some of the practical difficulties of chemical and agricultural industries and in ensuring effective co ordination between scientific research and industrial production The Laboratory will welcome close co operation with the Universities and other Research organizations in India It will also serve the Government Departments, including that of Defence, in the many problems referred to it

WHY STARS TWINKLE

According to the usual explanation, stars twinkle because the upper atmosphere is unstable Local turbulences alter the density and optical properties of the air As a result, the amount of light passing through it varies continually, and the stars appear to flicker This commonly accepted physical explanation is now challenged by a new physiological theory reported in British journal *Nature* H Hartridge of the Institute of Ophthalmology in London believes that the twinkling takes place not in the skies, but in our eyes

Hartridge based his theory on two well known facts (1) the eye is always in motion and (2) its rod shaped cells, which serve as Brightness meters', are not all equally sensitive The eye rests on a point for only about a tenth of a second and then shifts slightly to some other nearby point Because of these rapid jerking motions images continually move back and forth on the retina Since the rod cells in the retina vary in sensitivity, images seem to vary in intensity as the eye shifts

To test his theory that twinkling has nothing to do with the upper atmosphere, Hartridge experimentally observed artificial stars' at ground level Watching an electric lamp from a distance of several miles on a dark night he found that to the naked eye it twinkled "very obviously' But the twinkling disappeared when he used an eight power telescope On the basis of further experiments in his laboratory Hartridge believes he has found the explanation for this phenomenon A telescope collecting more light than the naked eye, makes the image considerably brighter Hence small local variations in the sensitivity of the retina's rod cells are not noticed In support of this conclusion, Hartridge notes that extremely bright stars do not twinkle and that many stars stop twinkling when viewed through a telescope The biologist did not, however, attempt to explain why stars twinkle more on nights of poor "seeing" than on clear nights

(*Scientific American*, February, 1950)

BERYLLIUM TOXICITY

The report of the toxicology Research Unit, Porton, Salisbury, on the experimental investigation of toxicological problems is that beryllium in the form of its soluble salts has a high degree of specific toxicity A satisfactory method for the microdetermination of beryllium in body tissues has been developed The acute liver necrosis that follows the intravenous injection of small doses of beryllium salts has been shown to depend on a rapid focal concentration of the metal within the liver it is this liver necrosis that causes death in such cases

Malignant bone tumours have been produced in rabbits by injecting the chemically insoluble beryllium silicates (*The Chemical Age*, February 4, 1950)

POLARIZER FOR INFRA RED RAYS

Existence of a plastic film that polarizes infra red heat rays was officially revealed at the annual meeting of the Optical Society of America Created during World War II for secret signalling and other military duties the film is expected to find a number of applications in science and industry

Like the polaroid material used in sunglasses, the infra red polarizer combs out the waves passing through it but the waves are the long invisible heat rays instead of shorter rays of visible light It is the first polarizer in convenient sheet form for the infra red rays Previous infra red polarizers have involved cumbersome reflecting plates It was invented during the war by Polaroid research scientist R P Blake

The new polarizer is effective over the region of the spectrum from 0 75 to 2 8 microns wavelengths used in infra red photography, communications and the analysis of materials In this range two pieces of the material transmit about thrity per cent of the heat rays when their axes or optical slots are held parallel, less than one per cent when their axes are crossed at right angles During the demonstration the intensity of a beam of infra red light is controlled at will, by rotating one of the new polarizers over another, gradually silencing a sound system energized by the beam

Describing the chemistry of the new polarizer, Blake called it the talented offspring of two earlier types of polarizers One of these, developed by Polaroid s president and director of research, Edwin H Land for use in sunglasses, is given its polarizing properties by stretching polyvinyl alcohol plastic to bring its molecules into alignment and then treating it with iodine The other, developed by Land and H G Rogers to meet the special high temperature conditions imposed by the proposed Polaroid headlight system, gets its properties from the treatment of the stretched polyvinyl alcohol film by dehydration Both are efficient polarizers for visible light, but give no indication of polarizing properties for the longer wavelengths Nevertheless, Blake created his new polarizer simply by combining the two treatments, first treating the polyvinyl alcohol plastic with iodine and then dehydrating it (*Journal of the Franklin Institute*, January, 1950).

ACTION ON THE SUN

Motion pictures taken at the High Altitude Observatory of Harvard and the University of Colorado was shown by Dr Donald H Menzel at the meeting of the American Association for the Advancement of Science in New York on December A study of some 15 000 feet of motion picture film taken since 1943 chiefly by Dr Walter O Roberts has led to a complete revision of the classification system for solar prominences and has resulted in a new theory of prominences flares, the corona and the relation of these phenomena to the earth said Dr Menzel

In such records of prominence activity downward moving matter appears to be much more prevalent than that rising upward Dr Menzel proposes that the source of the downward moving matter is the sun s polar spicules These comparatively small bright jets recently discovered by Dr Roberts are seen close to the sun s surface in its polar regions each shoots out a core of luminous gas that fades away while it is still rising Dr Menzel suggested that these expanding jets go to form the solar corona The curves of the corona follow lines of magnetic force The complex network of magnetic lines of force around the sun are to be regarded as a sort of semi flexible roof to the sun If the concentration of coronal material in some region becomes too great these lines of force will sag The prominences other than those associated with sunspots are largely due to such caving action

The motion pictures show many examples of matter (hot gases) streaming through a funnel shaped region whose shape remained relatively constant even though the matter itself was continually changing Occasionally the internal pressure of the gases moving inside the funnel is so great that the walls break and matter streams forth in graceful curves carrying the lines of magnetic force along with it

Long filamentary regions of prominences stretching as much as a million miles across the solar disk are possibly caused by a series of funnels with stretched zones between When the magnetic force lines tend to shorten suddenly they may account for rapidly expanding arch type prominences

From Dr Menzel s theory it may follow that any matter reaching the earth from the sun must come from the polar spicules The observed correlation of flares on the sun with magnetic storms 24 hours later on the earth would then simply mean that both had a common origin as Dr Menzel believes that flares do not necessarily eject material outward from the sun (*Sky and Telescope* February 1950)

RADIOACTIVE STANDARDS FOR CARBON 14

The National Bureau of Standards has prepared a series of standard ampoules of sodium carbonate solution containing definite, known amounts of carbon 14 These ampoules serve as comparison standards for the calibration of measuring instruments used in actual radioactive tracer work with carbon 14

The bureau s preparation of the carbon 14 standards have involved a carefully controlled chain of operations A sample of barium carbonate in which approximately 4% of the carbon atoms is carbon 14 was procured from the Oak Ridge National Laboratory and its ratio of carbon 12 to carbon 14 determined in a number of laboratories with the aid of the mass spectrometer A weighed amount of the radioactive barium carbonate was converted to sodium carbonate in a vacuum by allowing the sample to react with perchloric acid and collecting the evolved carbon dioxide in a solution of sodium hydroxide The standard ampoules were filled with a dilute solution of the enriched sodium carbonate whose disintegration rate was first carefully determined Carbon dioxide was liberated from the sodium carbonate solution in a vacuum by reaction with sulphuric acid frozen in a liquid air trap and then allowed to expand into an ionization chamber The amount of ionization which is proportional to the number of disintegrating atoms was determined with the aid of a vibrating reed electrometer

Another phase of the bureau s work on carbon isotope has been a redetermination of its half life which is approximately 6 000 years (*Chemical and Engineering News* January 9 1950)

PERMANENT NEUTRON STANDARD

The National Bureau of Standards has recently developed a primary neutron standard which makes it possible for all laboratories to measure neutron radiation intensities in terms of a common reference value The neutron standard consists of a solid beryllium sphere 4 cm in diameter enclosing at its geometrical center a capsule of radium The capsule is made of platinum iridium closely fitted to a gram of radium bromide compressed to maximum density Neutrons are produced in the beryllium sphere by the action of gamma rays from the radium Preliminary measurements indicate that the standard emits 1 1 million neutrons per second The rate of neutron emission will change slowly as the radium decays but this change is only about 0 04% a year and can be taken into account with sufficient accuracy

A duplicate standard has been prepared for loan to other research laboratories requiring standardization of their neutron measurements The standard is now ready for use and any future revision in the neutron emission rate will result in only a small correction to any data based on the present provisional value If as has been suggested the unit of neutron intensity is defined in terms of the new standard it will then be possible to express measurements from different laboratories in directly comparable units

The calibration of the permanent neutron standard was accomplished in the bureau s radioactivity laboratory by placing the beryllium sphere in an extensive absorbing medium which captures practically all of the emitted neutrons Boric acid was used as the absorber in such a concentration that most of the neutrons were absorbed by boron rather than hydrogen The source strength (the number of neutrons emitted per second) was measured by a mechanical integration scheme using indium and manganese foils as detectors of slow neutrons The beryllium sphere and four foils were suspended in the tank of boric acid while a synchronous motor drive carried the foils radially outward from the source at a predetermined speed taking either two or four hours to travel 15 cm

The foil activity was measured at the end of each irradiation period No detectable activity was observed beyond 20 cm from the source The number of neutrons emitted per second from the primary standard was given by the average of the values for the indium and manganese foils Calibration of the foils was accomplished in a fixed paraffin geometry in which uniform neutron flux was supplied by two quarter gram radium beryllium sources mounted on opposite sides of a boron trifluoride counter so that the counter would detect the alpha particles emitted from boron under neutron bombardment (*Chemical and Engineering News* January 16 1950)

ATOMIC ENERGY FOR DIAMOND

Atomic energy may possibly change the colour and other properties of gems especially diamonds It is suggested that hardness of diamonds may also be increased thus making the lower quality stones more suitable for industrial uses These possibilities are claimed in a recent patent open to public inspection

The method consists of the use of neutrons to produce permanent colour change by altering the pigmentation factors in the nuclear structure thus modifying physical and chemical properties *i e* transmutations *in situ* Neutrons must be so selected that they have no adverse effect on the main structure of the gem such as carbon in the diamond which might be converted into boron under energies of about 20 MeV

The nuclear reactions of impurities and colouring matter must be such that there is no risk of return of the initial element *e g* through the beta radioactive element as exemplified in the case of Al^{27} Other necessary conditions are stipulated as to the amount of neutrons per sq cm/sec and their appropriate action It is not unlikely that some impurities act as catalysts in the transformation of graphite to diamond with considerable shortening of the time factor It is not, however, necessary to wait a year for colour changes, for colour is due to a combination of factors including impurities It is claimed that after a few weeks irradiation the initial percentage of impurities will have changed and new pigments been formed (*The Chemical Age*, February 11, 1950)

ROYAL ASIATIC SOCIETY OF BENGAL

The Annual meeting of the Royal Asiatic Society of Bengal was held on Monday February 6, 1950 Hon ble Justice Shri Ramaprasad Mookerjee presiding

Speaking at the meeting His Excellency Dr Katju expressed hope that now that the people of India had formally established a Sovereign Republic scholars and historians would by careful research and investigation probe into the working of the national mind in past centuries and discover the basic principles which had appealed to the Indian people in regulating their own conduct He remarked what we urgently need today is a history of the Indian people themselves not of their kings or rulers

The Governor unveiled a portrait of *Vedacharya* Satya Brata Samasrami a Bengali Vedic scholar who was one of the earliest Indian Honorary Fellows of the Society

The Society s *Peace and Culture Medal for 1949* was awarded to Sri Aurobindo the philosopher saint of Pondicherry

Dr W D West received the ***Pramatha Nath Bose Memorial Medal*** for his contributions to the study of geology with special reference to Asia and Dr K V Krishnan the ***Barclay Memorial Medal*** for his work in medical science with special reference to India The ***Dr Bimala Charan Law Gold Medal*** for ancient Indian history went to Dr U N Ghosal, and the ***Sir Jadunath Sarkar Gold Medal*** for history to Dr Hari Ram Gupta

Justice Shri Mookerjee was re elected *President* and Dr Nihar Ranjan Ray *General Secretary* of the Society for 1950 51 The *Vice Presidents* elected were Dr M N Saha Dr M Siddiq Dr R C Majumdar and Mr K P Khaitan

The Society founded in 1784 by Sir William Jones will soon be known as the Asiatic Society the prefix Royal which it acquired in 1936 and the words of Bengal which crept in nearly 50 years after its foundation will be dropped

INDIAN DAIRY SCIENCE ASSOCIATION

The Third Annual General Meeting of the Indian Dairy Science Association was held on Wednesday March 1 1950 at Bangalore Dr K C Sen Director of Dairy Research presiding

The Association which was started in 1947 by leading dairy scientists in the country with the object of furthering the advancement of dairy science has made noteworthy progress in all directions The Association has been publishing a journal called *Indian Journal of Dairy Science* which is now running in its third year A non technical monthly Journal entitled *Indian Dairyman* is being published under the joint auspices of the Association and the Bangalore Dairy Cattle Society for disseminating knowledge to the layman

In the course of his Presidential address, which was read out by the Chairman, Sir Datar Singh pointed out the need for re orienting our cattle and dairy development policy keeping in view our financial resources the basic stock available, the conditions of milk production, economic position of the producer and purchasing power of the people For increasing milk production we have necessarily to depend on our indigenous resources, qualities and habits In this we have more and more to depend on the co operation of the people both in the productive sphere as well as in the marketing side and must organize producers' and consumers' co operative societies Considerable advance in this direction has been made in Madras Bombay Uttar Pradesh and elsewhere The Indian Council of Agricultural Research had sponsored the Key Village Scheme under which a coordinated programme of cattle development was to be launched and which envisaged measures like *providing approved breeding bulls giving* technical and veterinary aid to the producers supply of cattle feeds at reasonable rates and castration of all scrub bulls Encouragement was being given to various humanitarian organisation to salvage dry cattle from *cities and to establish Go sadans* in *interior* areas where unproductive cattle could be maintained on natural grazing and prevented from further propagation Sir Datar drew particular attention to the antisocial practice of adulteration of milk and milk products which should be eliminated quickly before the marketing of milk and milk products could be organised successfully

Sir Datar Singh, was re elected President of the Association *for the year 1950 51*

TELEGU ENCYCLOPAEDIA

The Telegu Bhasha Samiti, a linguistic Society established in October 1947 for the promotion and advancement of the Telegu language has undertaken to publish a Telegu Encyclopaedia in twelve volumes The twelve volumes will be respectively devoted to biology, zoology botany and geology, modern scientific medicine and Indian systems of medicine mathematics and astronomy, physics chemistry and atmospherics engineering and industry, agriculture forestry and veterinary science, fine arts, languages, literature and education, religion, philosophy, psychology and ethics, geography, commerce and economics history and politics, sociology and anthropology law and order, and defence and Telegu culture, language literature, and history A Sub-Committee has been constituted for each volume with experts for that branch of knowledge The whole project was worked out by a Planning Committee of eight members, including Sri T S Avinasalingam Chettiar, the former Education Minister

The notable feature of the encyclopaedia is that the volumes have been classified according to broad subjects and not alphabetically, as is the usual practice in such work. Within a particular volume, however, the alphabetical order will be followed In other word, each volume will be a self contained encyclopaedia for that particular branch of knowledge

This great enterprise of the Telegu Bhasha Samiti will doubtless be widely applauded The Samiti is presided over by Sri Bezawada Gopala Redd and the members of the Council include such able and distinguished men as Sri R B Ramakrishna Raju, Sri Vizayarama *Gajapathi* Raju *the Chief Justice* Sri *P* V Rajamannar and Sri H Sitarama Reddi The Samiti is at present housed in the University Buildings, Madras

ANNOUNCEMENTS

We regret to record the death of Rai Bahadur Dr N C Chatterjee Forest Entomologist, (retired), Indian Forest Research Institute Dehra Dun who was recently elected President of the Zoology and Entomology section of the next Indian Science Congress Session to be held at Calcutta in 1951, on February *26* last A distinguished Entomologist Dr Chatterjee was elected a Fellow of the National Institute of Sciences of India in 1942

Major General Sahib Singh Sokhey Director of the Haffkine Institute Bombay has been appointed Assistant Director General of the World Health Organization He is shortly leaving India to take up his new post

Dr D Chakravarty Lecturer in Chemistry, Calcutta University and Honorary Secretary, Indian Chemical Society is appointed Secretary Council of Post Graduate Teaching in Science Calcutta University A distinguished organic chemist Dr Chakravarty was elected a Fellow of the National Institute of of Sciences of India in 1949 He has been serving the Calcutta University since 1933

Dr A K Dutta Lecturer in Physics, Calcutta University and his co worker Sri B B Ghosh of All India Radio Calcutta Station have been invited to participate in International Conference of Ultra-Acoustics to be held in Rome from July 14 17 1950 The conference is being held under the joint auspices of the National Council of Research and the Association of Physics Italy and the International Union of Physics

Dr S L Hora Director Zoological Survey of India is appointed a Corresponding Member of the Zoological Society of London and an Associate Editor of the journal *Evolution* an international journal of organic evolution published by the Society for the Study of Evolution

To help India meet the immediate need for application of extension methods in betterment of agriculture the United States Government under Public Law 402 has set aside a few thousand dollars to enable some high Indian agricultural officials to proceed to America to study U S methods of agricultural extension work A detailed article on U S Agricultural Extension Service is published elsewhere in this issue

We have much pleasure in recording our grateful thanks to the Government of West Bengal for a grant of Rs 2 000/ only for the year 1949 50 to the Indian Science News Association in aid of our publication The following other scientific societies are also the recipients of grant from the West Bengal Government *Bangiya Bijnan Parishad*, Botanical Society of Bengal Calcutta Geographical Society Zoological Society of Bengal Calcutta Mathematical Society Science Club Calcutta, Indian Chemical Society, Indian Physical Society and the Physiological Society of India

Dr H K Nandi, Deputy Director of Agriculture, Government of Orissa is appointed Director of Agriculture West Bengal

ERRATA

In March 1950 issue p 358, column 2 line last but one read Symptoms in the citrus plants affected with corking and splitting after hard fruit ' and before splitting

On p 359 column 2, line 21 *read* Two *for* The

LETTERS TO THE EDITOR

[*The Editors are not responsible for the views expressed in the letters*]

THE TAJIK GALCHA ORIGIN OF PARSIS

I

Desai[1] has drawn certain conclusions which help to confirm my theory of the location of the original Aryan Home[3] in the region of the *Sir Amu Daria Doab* Desai has been at pains to prove that the modern Parsis definitely derive their ancestry from the Tajik and Galcha stocks of ancient Iran who were more Iranian then Arabian and with negligible differences have remained true to the type and that it was definitely Persia which brought about the brachycephaly of South Arabia and they were *the Tajik or Galcha ancestors of modern* Parsis These statements are no doubt true as the author with the aid of the geographical science after refuting such old theories as Tilak s theory of the Arctic Home of the Vedas have drawn a similar conclusion that the ancestors of the Parsis the Peshdadyans or the original ancestors of the Iranians first lived in the region occupied largely by Tajikistan and Badakshan, now a powerful political division of Russian Central Asia[2] These very parts have been identified by me with the *upper* Sir Daria and the *upper* Amu Daria in the neighbourhood of the Pamirs as the first Argar have After a comparative study of physiography and geography of this region from modern maps and records with the description of the original Aryan Home given in the *Vendidad* II and the *Bundahishn* XXV two of the precious relics of Zoroastrain literature I have hit upon this land of Tajikistan as the home of the settled Tajik population of ancient Iran in contrast to the aboriginal and nomadic population of Persia

No doubt Tajikistan after the wave of the Soviet system of Government has advanced miraculously not only with the aid of the descendents of the versatile Tajik people but also by means of the splendid natural resources particularly of this S E corner of Central Asia, *viz* the rich loess soil the silt laden and health giving waters of the Sir Daria which is largely snow fed and the bracing temperate climate There are besides some precious metallic ores also discovered in this particular region so that we may expect the rise of this Tajik Galcha tribe in U S S R to still greater heights in the near future

L Dudley Stamp also writes in his latest publication about this province as follows

> 'Tajikistan (Tajik Socialist Soviet Republic) was formed in 1929 of those portions of Bukhara and Turkistan inhabited mainly by Tajiks who speak a language allied to Iranian. They are Aryans and numbered 1 333 000 in 1933 The area of the country is 55 545 square miles The capital is Stalinobad (formerly Dushambe) and the state is remarkable for the development of motor roads Stalinobad is now not only linked by rail with Termoz but also by regular air services During the Czarist regime literacy was only 0 5 per cent It has now risen to 60 per cent The eastern part of this republic is Badakshan lying amongst the Pamirs The Russians have recently carried out intensive searches for minerals with important results

Thus the connection found by Desai between this ancient flourishing Tajik tribe and the modern Parsis is most heartening at a time when the Parsi community of Bombay and other centres on the west coast of India is going down Desai himself has drawn a very sad picture of the present state of affairs of this community that made a name in India as well as in Pakistan for their honesty of purpose capacity for adaptation to the environment and rare philanthropy The same author has complained of the community s decreasing fertility late marriages high infant mortality beggary and low vitality to withstand the weather or the market fluctuations Rightly he calls it A Community at the Cross Road This is particularly sad in face of the fact that the descendants of their original inhabitants in Tajikistan have so rapidly risen and are still a virile race Cannot something be done to bring together these counterparts of the original Aryan stock of human beings ? If any fresh blood is required and if the Parsis wish to preserve the great and good racial characteristics and the pristine purity of their religion and culture, would it not be well to bring the present day Parsis and the Irani Tajiks into contact with one another ? These are suggestions worthy of consideration by the leaders of this smallest and rarest community in the world The Parsis are anxious *to continue the noble traditions of a race, which, inspite of their fall in the political sphere, has maintained a high standard of morality, charity, duty and loyalty throughout these 13 centuries in India and Pakistan*

However much we wish for a total unification of the human race in the modern world there is always this sorting out of good and bad high and low pure and impure forward and backward, etc going on in nature and as citizens of the world, we must make the situation Not from any communal pride racial discrimination or differences of earthly acquisitions but from our willingness and eagerness to share our cultural characteristics and our ancient common heritage, do we Parsis desire to continue to remain in segregation still in this country If both India and Pakistan can yet be benefited by the self sacrificing spirit and life of the Parsis, as a separate community, without unduly mingling up with other communities then it is necessary that the policy of 'live and let live' should be followed in their case

MANECK B PITHAWALLA

Karachi, 7 11-1949

---

[1] Desai, S F *The Tajik Galcha Origin of Parsis*, SCI AND CUL *15*, 141 145 1949

[2] Pithawalla, M B Location of the Original Aryan Home and other early Aryan Settlements, *Ind Geog Jour 20* pp 37 to 62, and pp 1 to 28

[3] Dudley Stamp, L Asia, an Economic and Regional Geography Metheun London, 686 687 1944

[4] Desai, S P *A community at the Cross Road*, New Book Co Bombay 1948

II

I am glad to note from Pithawala's letter that he derives support to his theory of the Aryan Home from my article ' The Tajik Galcha Origin of Parsis The Doab formed by the Rivers Syrdarya and Amu darya (Jaxartes and Oxus respectively) is perhaps the most likely home of the ancient Iranians In a highly interesting work entitled the Duab of Turkestan W R Rickmers (1913) says that whether you turn to climatology, geology, zoology botany to the human races to political economy and history, you will find all the central and leading facts or types included in the Duab ' According to him the place has not changed much since historic times in spite of something known as Central Asian desiccation It may therefore be safely assumed that this part may have been the birth place of mankind or more possibly of the ancestors of the present day Parsis and of the Aryan Hindus somewhere 3000-5000 B C The Vendidad describes 16 beautiful places created by God for mankind one after another and some of them like Merv, Balkh, Herat, etc , fall within the area in question or near about W Geiger (Civilisation of the Eastern Iranians in Ancient Times 1885 translated by D P Sanjana), on whom Rickmers also relies writes (vol i p 9), "The Avesta expressly described the primitive home of the Iranian people the most holy Aryanavaija as being situated in the mountainous countries drained by the Sir, the Zerafshan and the Amu

Describing the Tajiks Rickmers says they are 'a mixture but more Aryan in every way' Describing the Galchas he says their children are sometimes strikingly European in their features These are the people called Galchas by many travellers and ethnologists Undoubtedly they look very Aryan more like Caucasian mountain tribes such as the Suanctians, than like the other races of the Duab That they are the remains of a former Indo Germanic population of Middle Asia seems not unlikely Like the Suarctians they have preserved memories of their old religion under the outer cloak of the later creed forced upon them The sacredness of fire evidently points to Zoroastrain worship

Thus looked at from anthropological, historical geographical and scriptural anglo Dr Pithawala stheory of Aryan Home in the Duab seems plausible

S F DESAI

Parsi Panchayet Office
Bombay
28 1 1950

IONIC ANTAGONISM IN CATION EXCHANGE REACTIONS—II

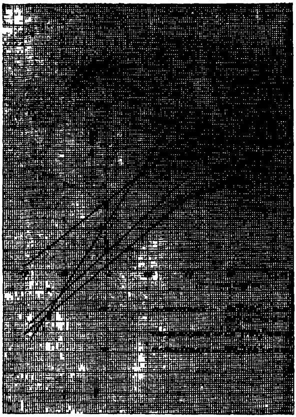
The competitive reaction between cations in exchange processes under equilibrium conditions was presented in Part I It is however important to study this type of interaction under dynamic conditions For this purpose a clay salt was leached with a mixture of electrolytes until the saturating cation was completely replaced The amount of the cations adsorbed by the clay from the mixture when compared with their relative adsorbabilities and or concentration ratios in the mixture, gives an idea of the influence of one upon the other

Various combinations of cations at three concentration ratios were used for the measurements The concentration of the cations was no doubt found to have a dominant effect But the ratios of concentrations in the solution which have certain fixed values are in general less than those on the solid phase This evidently indicates that there is suppression of the exchange of one cation or the heightening of the other or both The discrepancies are less marked in the case of the H bentonite system as the following results will show

Plots of the logarithms of m and c (columns 3 & 4) are more or less straight lines Although individual plots vary appreciably in their slopes the average values of m and c can be put into the form $m = 0\ 56\ c^{1\ 08} - c/2$

This suggests that the ratio of the cations in the solid phase of the clay is on an average double of that in the leaching solution If the relative entry of the cation is compared with their symmetry values it is found that the more adsorbable cation even when its concentration is low often suppresses the entry of the less absorbable one This general finding is thus in conformity with that observed in the case of ionic antagonism under equilibrium conditions (Part I)

System	Electrolytes	Ratios in solution (*m*)	Rations on the clay (*c*)
H Bentonite	$BaCl_2 + NH\ Cl$	5 0	9 5
		1 0	2 3
		0 2	0 26
	$BaCl_2 + CaCl_2$	5 0	4 5
		1 0	1 1
		0 2	0 29
Na-bentonite	$CaCl_2 + NH_4\ Cl$	5 0	25 0
		1 0	6 3
		0 2	1 9
K-bentonite	$NH_4\ Cl + Nacl$	5 0	43 4
		1 0	1 8
		0 2	0 57



My thanks are due to Dr S K Mukherjee for his continued interest in the work

SHANKARANANDA MOOKERJEE

Uuniversity College of Science and Technology
Calcutta 5 12 1949

COLCHICINE INDUCED POLYPLOIDY IN *AMARANTUS BLITUM*

The results obtained so far by various workers[1,2,3,4] indicate that although the effect of colchicine on fruit and seed setting has not given promising results, this treatment has generally given increased vegetative growth For this purpose some of the leafy vegetables were selected for study and preliminary results on *Amaranthus blitum* commonly known as Cholai' and used as a leafy vegetable are reported here

The most successful treatment for the production of polyploids was found to be 0 10% colchicine applied to the growing point for 13 hours The first noticeable effect of colchicine treatment was a temporary arrest of growth The leaves coming out just after the treatment were characteristically thick and appeared abnormal in shape The subsequent leaves however were not so thick 30 day old treated plants had thicker stems more number of leaves and branches larger and darker green leaves and were as tall as the untreated plants The above observation is further supported by higher fresh and dry weights of different parts of the plants after 35 days of growth It is also worthy of note that water content of the treated plants is higher

TABLE I

MEASUREMENTS OF CAMERA LUCIDA DRAWINGS

	Size of stomata (cm. × 550)		Size of pollen (cm. × 550)
	Length	Breadth	
Diploid	1 62	1 30	1 10
Colchicine—treated	2 62	1 71	1 45

The treated plants were further characterised by larger stomata (Table I) lesser number of stomata per unit area bigger pollen grains (Table I) lateness in flowering and maturity and bigger seeds with delayed germination There was however variability in the size of the pollen and the seed of the treated plants 10 20% sterility was also found in the pollen grains of treated plants The stomata the pollen grain size and the temporary acetocarmine smears of pollen mother cells were used as criteria for preliminary selection of polyploids

Larger darker green and greater number of leaves per plant and prolonged period of vegetative growth in colchicine treated plants suggests a possibility of producing a superior type The C_2 generation is being raised and detailed results will be published elsewhere

S L TANDON
J J CHINOY

Department of Botany
University of Delhi
24 12 1949

---

[1] Dermen, H *Bot Rev* 6 599 635 1940
[2] Muntzing A *Hereditas* 21 263-378, 1936.
[3] Nobel B R. *Amer Nat*, 75 289 365 1941
[4] Stebbins G L *Advances in Genetics*, 1, 403-429, 1947

OPTICAL SPECIFICITY OF PROTEIN HYDROLYSATES.

A previous note on the 'Optical specificity of protein hydrolysates'[1] prepared by enzymatic digestion shows a linear relationship between the specific optical rotation and the degree of hydrolysis, each protein having its distinct and characteristic path of different slope. A similar study has been undertaken with the acid hydrolysates of those proteins in order to examine as to whether the acid hydrolysates would maintain the same optical specificity under the conditions of the acid hydrolysis The results so far obtained are being recorded in this note

It is found that each acid hydrolysate from the different proteins exhibits its characteristic path on a newer scale of assymetry, but all are of the same slope unlike the enzymatic hydrolysates Two proteins of the vegetable source have also been included in the study and their acid hydrolysates are being found to differ from those of the animal proteins in that they form a set of parallel paths of a different slope

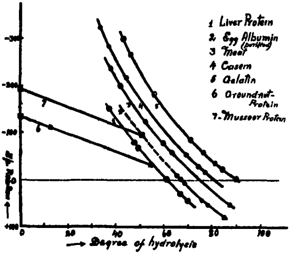


Fig. 1

The curve for each protein tends to indicate its molecular pattern. The specific optical relation of their hydrolysate at the stage of 50% hydrolysis, again provides a specific number for each protein, the number being expressed at the tangent of the angle subtended at the origin by the point on the curve at 50% hydrolysis of the protein The specific nnmber may in this way be 1.4 for liver, 2 25 for albumin, 3 04 for meat, 3 3 for casein and 4 9 for gelatin. Similarly the vegetable proteins give a different set of specific number *e g.*, 1.9 for *mussoor* protein, 0 6 for groundnut protein, etc. This protein number would very advantageously facilitate indentification as well as nature of proteins and their hydrolysates, in certain cases. The curve in fig. I also tend to show that the liver protein is most probably of the least complicated nature.

My sincerest thanks are due to Dr. U P Basu for his interest in this work.

N Ray

Bengal Immunity Research Institute,
Calcutta 16, 13 12 1949

---

[1] N Ray, SCIENCE & CULTURE, *14*, 386, 1949

[2] Hausmann, *Z Physiol Chem*, *27*, 95, 1899,

DOUBLE STAINING WITH ACETO CARMINE AND OTHER RAPID TECHNIQUES—IV*

Contrast staining is a well known and widely practised technique It facilitates critical study and observation by emphasizing the diffierentiation between the constituent elements of the material under investigation Further, it imparts added brilliance and beauty to the preparation, especially when complementary colours are used But as far as we are aware, it has not, so far, been available with aceto-carmine and similar rapid techniques, which, therefore, compare unfavourably in this respect, with the more elaborate permanent preparations

As already reported, however, we have succeeded, in our present studies, in introducing a contrasting cytoplasmic stain into such techniques, *viz*, aceto-carmine, aceto- haematoxylin[2], acetic orcein etc The procedure is simple and may be illustrated with reference to aceto carmine

Pollen grains, fresh, preserved or pre-treated [2,3,4] are stained with aceto carmine (saturated solution in 45% acetic acid in 55% or weaker — glycerine[5]) as usual Thereafter, they are irrigated with the glycerine acetic-acid mixture to remove the extra stain This is followed by light green in acetic glycerine (45 55) Only a trace of light green should be dissolved to give a medium green colour The tinge, however, can be varied according to convenience The preparation may be slightly warmed

The grains so treated show the cytoplasm stained pleasant green, against which the nucleus, originally stained red, stands out conspicuously as a more or less magenta coloured structure due to the enveloping green cytoplasmic screen The vegetative nucleus also shows up, though less deeply stained than the generative Preparations thus made retain their colour effects for prolonged observations, and possess the brilliance and all the advantages of the double staining by the customary methods. The technique is, therefore, a valuable adjunct to cytological studies by rapid techniques

Suitable contrast stains have been similarly combined with other rapid nuclear stains, *viz*, aceto haema-

---

*These studies have been financed by the Scientific Research Committee of the U. P Government.

toxylin with light green with acetic-orcein and with orange-G We are trying other combinations also

N K TIWARY
SHANKERJI SHRIVASTAVA

Botany Department
Banaras Hindu University
28 12 1949

Tiwary N K & Shrivastava Shankerji SCIENCE & CULTURE *15* 37 38 1949
[2] Tiwary N K *Proc Ind Sc Cong* IV 3 1949
[3] ——SCIENCE & CULTURE *13*, 390 1948
[5] ——&Shrivastava, Shankerji SCIENCE & CULTURE *15* 364 950
[3] Tiwary N K *Proc Ind Sc Cong* III 81 1945

A SIMPLE METHOD OF OBTAINING DIFFERENCE EQUATIONS OF PROBABILITY GENERATING FUNCTIONS OF CERTAIN DISTRIBUTIONS

The author[1] has obtained difference equations satisfied by the moment generating function of a number of distributions arising from *m* points possessing one of *k* characters arranged at random on a line It is well known that the probability generating functions can be derived by substituting $e^{t} - \xi$ in the moment generating function The methods used for working out the moment generating functions are not of such wide applicability In fact it is very difficult to obtain the difference equations satisfied by the moment generation functions of any of the distributions arising from points on a lattice Recently the author has been able to get the probabilit generating functions by another method which is described below for the distribution of black white joins for points on a line

Let *p* and *q* be the probabilities of the points assuming the colours black and white respectively The probability generating function is defined as usual by

$$\phi(m) = P(o) + \xi P(1) + \xi^2 P(2)$$

where $P(r)$ is the probability for *r* black white joins Now let $P_1(m\ r)$ and $P_2(m\ r)$ represent the probability for *r* joins when the first point of the arrangement of the *m* points is black and white respectively It can be easily seen that P_1 and P_2 for black white joins satisfy the following difference equations

$$P_1(m\ r) - p\ P_1(m\ \ 1\ r) + p\ P_2(m\ \ 1\ r-1)$$

$$P_2(m\ r) = q\ P_1(m-1\ \ r-1) + q\ P_2(m-1\ \ r)$$

Similar equations have been given by Wishart and Hirschfeld[2] also But they have not used them to obtain the probability generating functions

Substituting the above equations in $\phi_1(m)$ and $\phi_2(m)$ the probability generating functions corresponding to $P_1(m\ r)$ and $P_2(m\ r)$ they reduce to

$$\phi_1(m) = p\ \phi_1(m-1) + p\ \xi\ \phi_2(m-1)$$

$$\phi_2(m) = q\ \xi\ \phi_1(m-1) + q\ \phi_2(m-1)$$

Eliminating the ϕ's from the above equations we get—

$$\begin{vmatrix} (E-p) & -p\ \xi \\ -q\ \xi & (E-q) \end{vmatrix} \phi(m-1) = 0$$

where E is the operator used in Finite Difference

The method outlined above has been found to be very powerful in obtaining the difference equations of probability generating functions of a large number of distributions arising from points of different characters distributed in the form of a lattice The difference equations will enable us to prepare the probability tables for the distributions Further since the difference equations give the moment generating functions they can be used to show that all the cumulants of the distributions are linear functions of the total number of points on the lattice and its sides

Full details will be published shortly in the *Journal of the Indian Society of Agricultural Statistics*

P V KRISHNA IYER

Indian Council of Agricultural Research
New Delhi 9 1 1950

Krishna Iyer P V *J Ind Soc Agri Stat 1* 173 1948
[2] Wishart J and Hirschfeld H O *J Math Soc* London *11* 227 1936

BOND ENERGY AND IONIC NATURE OF BONDS IN POLYATOMIC MOLECULES

It has been previously shown by us[1] that the total energy of a bond A B is the sum of both the ionic and covalent contributions *i e* $D(A\ B)\ \ \sqrt{D(A\ A)\times D(B-B)}\times(1-i)+\Delta i$ where D(A—B) D(A—A) and D(B B) are the energies of the bonds A—B A—A and B B respectively i is the ionic nature of the bond A—B is given by $\frac{Z_A}{Z_A+Z_B}\times n$ where Z^A and Z^B are the nuclear charges of the atoms A and B Δ is the energy due to the partial ionic nature of the bond This relation has been successfully applied in the case of simple diatomic systems like hydrogen and alkali halides. It has been shown that the ionic binding energy Δi is equal to ie^2/r

The object of this note is to point out that similar relationship holds good for the bonds in polyatomic compounds The energy due to the partial ionic nature of the bond is however $ie^2/2r$ *i* half the value of the Coulombic energy

Table I gives the results of such calculations.

The values of ionic natures given in col (3) as calculated from the relationship[2] $(Z_A/Z_A+Z_B)\times n$ where Z_A and Z_B are the nuclear charges and n a screening constant, are in good agreement with the observed values

TABLE 1

Bond (A B)	Energy D(A B)	Dist.	Ionic cal	Nature obs.	Ionic Cal	binding energy Obs
	P	$\frac{\gamma_0 A}{P}$	$\left(\frac{ZA}{ZA+ZB}\right)^2$	$\frac{h}{e\gamma}$	$\frac{e^2}{2\gamma}$	Δ_1
O-H	110.2	0.96	0.44	0.53	76	75
S-H	87.5	1.34	0.18	0.17	22	21
N H	83.7	1.00	0.33	0.78	51	55
P H	63.0	1.46	0.20	0.24	22	21
As-H	47.3	1.56	0.09	0.07	10	11
P-Cl	62.8	2.00	0.47	0.43	39	45
P Br	49.2	2.23	0.30	0.26	22	2llc
As-Cl	60.3	2.16	0.66	0.60	56	nca 60
As Br	48.0	2.23	0.48	0.45	34	34
As-I	33.1	2.54	0.39	0.36	25	29
C H	87.3	1.07	0.07	0.08	13	15
C-F	107.0	1.41	0.20	0.21[2]	47	58
C-Cl	66.5	1.76	0.19	0.18	18	19
C-Br	54.0	1.91	0.15	0.15	12	10
C I	45.5	2.10	0.11	0.12	8	4
C-S	54.5	1.81	0.14	0.12	1.3	1.7

p—Pauling *The Nature of the Chemical Bond.*

obtained from the data on bond moments calculated from the dipole moment values

Except in the case of C F the agreement between the observed and calculated ionic binding energies is quite within the uncertainties of the bond energy values

S K KULKARNI JATKAR
(Miss) S B KULKARNI

General Chemistry Section,
Indian Institute of Science,
Bangalore 3, 23-1 1950

[1] S K. K. Jatkar and S B Kulkarni, *Curr Sci*, *18*, 131, 1949
[2] " " " *18*, 130, 1949

THE FOOD OF *RANA HEXADACTYLA* LESSON, IN RELATION TO FISHERIES *

Though the Indian bull-frog *Rana tigerina* Daud is regarded as a predator on fishes[1], there is no record showing whether the South Indian frog *Rana hexadactyla* Lesson is detrimental to pisciculture The present investigation was undertaken to ascertain the facts in this connection This frog is common around fish-rearing establishments in South India, Two hundred and fifty specimens of it were collected from various localities, such as departmental fish farms and nurseries, swamps, canals, rivers, and tanks, and their stomach contents were determined both qualitatively and quantitatively

The following table shows the results —

TABLE I
STOMACH CONTENTS (FOOD) OF *Rana hexadactyla*

Name of food organism.	*Frequency of occurrence in the stomachs of the 250 individuals*	*Largest percentage by volume in a single stomach*
I PLANT ORGANISMS		
Hydrilla	65	80
Ceratophyllum	28	100
Spirogyra	36	100
Potamogeton	15	100
Najas	8	100
Chara	5	80
Oxalis	19	100
Grass blades and stem	32	70
Leaves and flowers of rain tree	51	100
Leaves of margosa tree	16	15
II INSECTS —		
Dragon flies and larvae	16	20
Laccortephes	44	100
Lethocerus	30	60
Ranatra	18	20
Plea	26	20
Gerris	13	60
Hydrometra	8	30
Corixa	17	50
Dityscus	17	100
Cybister	22	65
Gryllotalpa	1	60
Black ant (*camponotus?*)	2	20
III MOLLUSCA —		
Limnaea	21	20
Bythinia	3	5
Indoplanorbis	13	20
Viviparus	11	10
IV CRUSTACEA —		
Gelasimus	3	100
Palaemon	1	20
V FISHES —		
Etroplus maculatus	1	100
Gambusia affinis	2	50
Lebistes reticulatus	2	100
VI MISCELLANEOUS —		
Stones	2	15
Twigs	4	20
Silk cotton	1	20

The dietary has a wide range and the stomachs examined showed 34 recognizable items The frog feeds mostly on water insects, water plants, and leaves and flowers of shore trees and rarely on fishes The latter were discovered in only five stomachs and were of a small size and of no economic importance The feeding habit thus seems to be mainly related not to fishes, but to the principal plant and animal organisms of the locality It would be wrong to particularise a "fish diet" for the species

While it is improbable that this frog adversely affects the production or yield of the inland fisheries, it may be indirectly of some advantage It is not unlikely that reptiles, birds, fish. otters and many other forms prey upon it and its tadpole If it were not present, its enemies would perhaps feed upon fishes of commercial importance and thus harm fisheries To cite an analogous case[2], the Board of Fish Commissioners in Pennsylvania is stocking lakes and ponds with frog tadpoles along with fishlings so as to provide food for the animals that would otherwise prey upon valuable food and game fish

We are grateful to Prof Beni Charan Mahendra, for his criticism and suggestions in the preparation of the present note

P I CHACKO
B KRISHNAMURTHI

Freshwater Biological Station,
Kalipauk, Madras.
1 2 1950

---

[1] Bhaduri, J L *Sci* and *Cul* , *11*, 205, 1945.
[2] Buller, C R *Pennsylvania Anglep* , *16*, 1, 1947

* Communicated with the kind permission of the Director of Fisheries, Madras (See also *Proc 37th Ind. Sc Cong* III, 258, 1950)

ABNORMALITIES IN THE FLOWERS OF *VINCA ROSEA* LINN

Vinca rosea Linn a native of the West Indies is commonly grown in Indian gardens Its white or purplish pink flowers appear almost all the year round On July 1946, the author noticed on one plant a branch having some flowers completely turned green instead of normal purplish pink, other flowers had turned partially green Besides flowers, vegetative shoots were also affected in various ways

The green and partially green flowers showed the following abnormalities

(*a*) Gradual decrease in the size of the flowers, (*b*) elongation of pedicels, some reaching a length of 20 to 25 mm , (*c*) enlargement of the sepal lobes into long slender linear foliaceous structures , (*d*) change of salver shaped corolla into short green petals, each appearing like a stalked leaf , (*e*) gynaecium absent or modified into leaf-like structure , (*f*) reduction in the length of the style , (*g*) the two green bodies at the base of the ovary growing into two short shoots with tiny leaves , and (*h*) much proliferation All these are illustrated in figures 2-9 Fig 1 shows the normal flower of *Vinca rosea* L.

The stamens were quite normal and had not undergone any change Pollen grains appeared to be normal, but were not so numerous as in normal flowers Either one or both the axillary flowers at a node showed abnormalities, but the first condition was much more frequent, the latter rather rare,

Similar changes were seen also on other branches and affected vegetative shoots. The most characteristic feature of the vegetative shoots was reduction in the size of the leaves New leaves became smaller and smaller with result that in course of time the leaves were very considerably reduced Both the petiole and the lamina were involved in the reduction of the leaves The average size of the full grown normal leaf is about 7 to 8 cms by 2 to 3 cms. The maximum size of fully developed abnormal leaf was found to be only about 3 5 cms long and 0 7 to 1 cm broad Further there was a change of colour in the leaves Normal leaves are deep green, while the abnormal ones were pale yellow green The yellowish leaves also *fell off* early

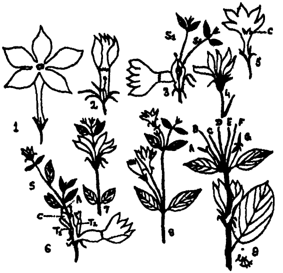


Fig 1 A normal flower Fig 2 An abnormal flower showing enlarged foliaceous sepals, ruptured corolla tube and curled style. Fig 3 Another abnormal flower showing enlarged ovaries, reduced style and two shoots in place of two lateral tiny bodies Fig 4 An abnormal flower with corolla of free petals Fig 5 Phyllody of carpels Fig 6 An abnormal flower showing a branch (A) from the apex of the thalamus in place of one of the carpels which is raised and borne laterally and modified into a leaf (C) This axis has grown further and bears leaves and branches and ends in a flower showing phyllody Two tiny bodies, T_1 and T_2 are developed into elongated structures. Fig 7 Branch C of Fig 9, showing opposite leaves and a flower having calyx and corolla and a shoot arising from the apex of the thalamus in place of the carpel Fig 8 Branch B of Fig 9, showing opposite leaves and pairs of axillary flowers in the axil of two of these leaves Fig 9 Proliferation of the flower showing calyx, corolla and an axis arising from the apex of the thalamus in place of a carpel This bears opposite leaves and branches A,B,C,D,E,F and G

Besides these changes a further change observed was the stimulation of growth of axillary buds, including the dormant buds. This also resulted in shortened branches with reduced leaves Ultimately these got crowded at the axils and the plant took up a characteristic bushy appearance, commonly known as witches' broom. At this stage the appearance of the plant was so much changed that it was difficult to recognise its true identity Further it was noticed that these shortened branches with reduced leaves did not bear flowers and hence no fruits with seeds were set These shoots became sterile and absolutely useless to the gardener for flowers Root system of the affected plant consisted of stout shortened tap root with numerous fibrous surface spreading lateral roots arising very close to the base of the tap root

In order to study further abnormalities several flowers from various healthy plants were examined and three more abnormalities were noticed They were (i) variation in the number of corolla lobes from 3 to 6, (ii) transformation of the entire corolla into a bilobed or trilobed structure and (iii) corolla lobes with much divided margin instead of entire

The fact that in these abnormal flowers both the sepals and petals had become persistent and the latter also virescent shows that the flowers of *Vinca rosea* described in the present paper were affected by a change of the nature of phyllody The two fleshy green bodies raised somewhat higher than the carpels and placed alternately with them can be regarded as enations of the receptacle That they give rise to shoots (Fig 3) shows that they are capable of further growth The proliferation of the flowers (Figs 6 7 & 9) also proves that the floral axis is capable of further growth

More or less similar types of abnormalities have been recorded in *Argemone mexicana* Linn[6], in *Sesamum indicum* Linn[4], in *Crotalaria striata* D C [3] and in *Angelonia grandiflora* C Morr[13]

Discolouration, phyllody, dwarfing, hypertrophy atrophy, proliferation, etc are sometimes symptoms of disease in plants Diseases in several species of *Vinca* have been recorded by Kerner and Oliver[7], Metcalf and Flint[8] and Butler and Bisby[1] Diseased *Vinca rosea* is recorded by Dastur[5] Similar symptoms causing disease in economic plants are recorded in brinjal, tomato, chillies and cotton by Chibber[2], in brinjal by Thomas & Krishnaswamy[9], in *bhindi*, cotton and cardamon by Uppal *et al* [10,11,12] Macroscopic and microscopic examination of these metamorphosed shoot of *Vinca rosea* however did not reveal the presence of any causative organism This disease did not spread by affecting other plants Self sown plants round about the parents were all healthy and normal Seeds from the healthy unaffected branches of these diseased plants gave rise to normal healthy plants proving that the disease is not hereditary and not transmitted by seeds As there was no natural transmission of disease artificial methods of self infection and grafting were tried, but these also were found ineffective

The author is indebted to Prof. A C Joshi for his kind interest and help during the investigation.

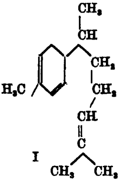
G A. Kapadia

Bahauddin College,
Junagadh,
27-2-1950.

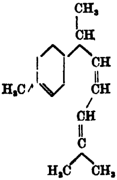
[1] Butler, E J. and Bisby, G R. Imp. Coun. Agri Res. Ind Sci Meno *1*, 31, 1931
[2] Chibber, H M Dept. Agri Bom *Bull No 65*, 1914
[3] Cooper, R E *Jour Uni Bom* 6 pt *V* 57 61, 1938
[4] Cooper, R E and Gonsalves, E *Jour Uni Bom. 4* pt V, 1 6, 1936
[5] Dastur J F *Mem Dept Agri Ind Bot. Ser* VIII *6* 233 242, 1916
[6] Joshi, A C *Jour Ind Bot Soc 12* 255 71 1933
[7] Kerner, A and Oliver, F W Natural History of Plants *2*, 525 1895
[8] Metcalf C L and Flint W P Destructive and Useful Insects 704 1928
[9] Thomas K M and Krishnaswamy *Proc Ind Acad Sci.*, (B) *10* No 2 201, 1939
[10] Uppal B N Varma, P M and Capoor S P *Curr Sci*, *11*, 227 1940
[11] Uppal B N Capoor S P and Raychaudhuri, S P *Curr Sci 13* 284 5 1944
[12] Uppal, B N Varma, P M and Capoor S P *Curr Sci*, *15*, 208 9 1945
[13] VenkataRao C *Jour Ind Bot Soc 25* 7 1946

STRUCTURE OF ZINGIBERENE

In a recent communication[1] Eschenmoser and Schinz have suggested a change in the disposition of one of the double bonds in zingiberene, the conjugated system of double bond being located in the ring—a conclusion based on the results of condensation of zingiberene with acetylene dicarboxylic ester On the evidences put forward by the above authors the suggested structure I appears to be more satisfactory



I



II

The structure II proposed by Ruzicka and van Veen[2] has been synthesised by me[3], but the attempts to prepare solid derivative such as dihydrochloride of isozingiberene[4] from the synthetic product II, being unsuccessful, the structural identity or otherwise of the synthetic product with natural zingiberene could not be established although both have refractive indices very close to each other, and in spite of the fact that they behave similarly on sulphur dehydrogenation except that the yield of cadalene from the synthetic product was very poor

Now, in view of the proposed change in the structure, experiments are in progress in this laboratory to synthesise the new structure I as well as to prepare more of II in order to make a comparative study of the infra-red and/or ultra-violet absorption spectra of the synthetic products and natural zingiberene, which only can solve this intriguing structural problem

S M Mukherji

Department of Organic Chemistry,
Indian Association for the Cultivation of Science,
Calcutta, 21 2 1950

---

[1] Eschenmoser, A. and Schinz, Helv *Chim Acta*, 33, 171, 1950

[2] Ruzicka and van Veen, *Annalen*, 468, 143, 1929

[3] Mukherjee, *S M J Ind. Chem. Soc.* 25, 155, 1948.

[4] Semmler and Becker, *Ber*, 46, 1814, 1913; Ruzicka and van Veen, *loc cit.*

BOOK REVIEWS

Physical Aspects of Colour—By Dr P J Bouma, Philips Technical Library, Eindhoven Holland (English Edition) Pp 312 Price 30s

The book is intended to provide an account of the different principles of colour stimuli and colour sensations The author has assumed hue, saturation and brightness as three parameters of colour diagram to explain colour sensation Colour triangle, colour space and colour co ordinates have been treated in a masterly way with simple geometry and mathematics

A brief account of colour is followed by definitions of subjective and objective brightness luminous intensity and other photometric quantities The colour 'white' is explained by a spectral reflection curve with reference to standard light sources, such as Illuminants A, B C, and the equal energy source E According to convention a colour triangle is formed with three selected spectral colours and is represented by three primaries R, G, B and a white point W Then in order to express the various chromaticities by numbers, an equilateral triangle XYZ is drawn which encloses completely the curve and the locus of the spectral colours within its boundary Thus chromaticity is characterized by the ratio of three numbers Two quantities are required to explain colour mixtures, dominant wavelength and colorimetric purity or the degree of saturation

The three dimensional representation is needed to specify a colour completely, in which colour space is substituted for colour plane The three fundamental laws of colour mixture, that is Grassmann's first, second and third laws, have been developed with vector co ordinates The internationally recognized system of colour co-ordinates XYZ, known as the "C I E system ' and its application on the transformation from one set of axes to another has been thoroughly discussed The law of addition for the mixture of colours of two co ordinates is illustrated with examples and the rule for calculating the monochromatic co-ordinates of a colour from its trichromatic co-ordinates and vice versa is explained

The chapter on special light sources and colours deals with black body radiation, colour temperature determination and different system of boundary colours observed when an illuminated edge is viewed through a prism Two chapters on objective and subjective colorometry give a detailed account of the colour phenomenon with the photoelectric cells and trichromatic colorimeters A survey of defective colour vision and its hereditary characteristic, is followed by an account of the historical developments and theories of colour science Different aspects on discriminations and adaptation, and other factors on colour reactions are also discussed The last chapter deals with the practical applications of colour phenomenon so far discussed in illuminating engineering, and other trade and industry and also with methods of colour reproduction In the appendix ten tables of data for colour calculations in RGB and XYZ system are given.

The theoretical development of colour problem is based on Schrodinger's work during 1920 1926, but detailed mathematical treatment has not been followed in the book The author has given stress on the expression of colour by numbers and on the calculation and measurement of colours from simple geometrical considerations

We are thankful to Dr P J Bouma for this valuable handbook on colour measurement which he wrote in Dutch in April 1945 during his serious illness that ultimately brought an end to his life in January, 1947

B M.

Biological Action of Sex Hormones—By Harold Burrows Second Edition (1949), Cambridge University Press Price 42 sh net

This very useful and instructive work do not require any special introductions to the students of Endocrinology It gives information and data regarding the different aspects of the working of the sex glands and other endocrine organs which work in co-ordination with these and the regulation of sexual functions

The Second Edition has been considerably reset with valuable additional information and discussions, simplifying most of the problems dealt in the different chapters. These additions are not only from the literature which has been published since the last addition, but many are from older work, which has been introduced to clarify and deal with the subject more intimately. The chapter on Oestrogen, for example, has been so enlarged that it now occupies about double the number of pages than it did in last edition, with added items of study, such as, Oestrogen acquired from the environment.

The work has tried to perform the task of placing before the students of Endocrinology important results and data of a branch of science which so radically affect the structure and functions of the body and which is expanding rapidly.

B, B. S

Water Supply Engineering, 4th Ed. 1949—By Harold E. Babbitt & James J. Doland, Published by McGraw Hill Book Co. Inc.

The authors of the book are well known professors in the University of Illinois, U.S.A. and this new edition with timely revision and a well arranged index will definitely prove very useful to Degree students in Civil Engineering.

Within a compass of about 600 pages the whole subject of Water Supply Engineering including Hydraulics has been treated in a very thorough and systematic manner with an excellent introduction on the historical side.

There is, however, a little mistake in naming 'Susruta' as 'Ousruta' (Page 4). The chapters on Pumping Machineries and Electrical Equipments are special feature which have greatly added to the value of the book. The chapters on Water Analysis, Sand Filtration, Softening Disinfection and other miscellaneous methods of purification are quite comprehensive and useful not only to the students but also to the practising engineers as a reference book.

B. N C

Must We Hide—By R. E. Lapp. Addison Wesley Press Inc., Kendall Square Building, Cambridge 42, Massachussetts, U.S.A. Cloth, 5⅝"×8⅜", with dust proof-cover, pp x+182, 1949. Price $3.00

Written by an American physicist and one time member of the famed Manhattan Project and now Executive Director of the Committee on Atomic Energy of the Research & Development Board of the National Military Establishment, this book is an appraisal of the power and limitations of the atom bomb. There are three main themes on which the author has based the 14 chapters of his text *viz*: the actual observed effect of the bomb in Japan, its possible mode of attack and destruction in future, and the means of defense. In a clear and lucid manner, a mass of unfamiliar facts are brought to light as regards the nature of casualties and the lack of medical attendance in Hiroshima, and the effect of radiation emitted by the atom bomb as compared with the normal radiation absorbed by us from cosmic rays and medical x-ray examination. In going through the chapter dealing with radiation, the reviewer was reminded of another recent publication, *viz.*, Dr. David Bradley's "No Place To Hide" (Hodder & Stoughton, 1948), in which the author admirably surveys the subject of radioactive contamination—a working knowledge of which he obtained as a member of one of the Bikini monitoring crews. As a surgeon Dr. Bradley describes the Bikini blast, interweaving the theme with a vivid panorama of the series of emotional experiences. Dr. Lapp in his book deals with this test from a purely scientific view point and although it lacks colour as may appear to some, its profoundness and deep significance with future wartime operations will be appreciated by all. In discussing the varied phases of strategic and tactical bombing over Japan and Germany, the author brings to light the fact that more destruction can be caused by a 1000 plane raid than by an atom bomb.

To the uninitiated, a digress on the effects of an atomic bombardment in U.S.A. is very interesting. Basing his comparison on the Bikini test a vivid description is unfurled of what would happen if an atom bomb is dropped in a river or smuggled into the basement of a skyscraper, or released in a main street or on the top of a tall structure. "The problem of atomic defense is a great one but it is not hopelessly great", writes Dr. Lapp in the opening chapter. The best defense really consists in preventing the atom bombs from being brought into the target country by any and all means. According to him this entry can be prevented by intelligence interception through trained observers; increasing defences by radar and other patrol; and providing interceptive devices like planes and missiles. In the chapters dealing with planning, decentralisation and dispersion, engineers will find much food for thought regarding problems of communication and transport in bomb stricken areas, design of concrete and underground shelters, radiation effects on existing building like skyscrapers and other effects on dams and industrial plants. The layout of three types of cities termed by the author "satellite", "doughnut" and "rodlike" cities with diagrams and a careful analysis is worthy of serious consideration by all engaged in town planning.

In concluding, the author rightly stresses the social implications of atomic warfare, by discussing such topics as the availability of public information on the number of atomic bombs the country is manufacturing, the expenses of maintaining plants, and the prognosis of another war, which Dr. Lapp believes will not take place till 1960. "Mankind cannot continue to stand in fear of the greatest scientific accomplishment of our time", said Dr. Clark Goodman, Nuclear Physicist of Massachussetts Inst. of Technology. This book goes a long way in dispelling this fear and in producing a rational and correct picture of the potentialities of the atom bomb Nicely bound, clearly printed in bold types and containing over 30 interesting pictures, the book should be read by all who are to call themselves civilised homosapiens.

S. K. G

Fungi of Bengal—By T. C Roy, M Sc, Published by the Botanical Society of Bengal, 35, Ballygunge Circular Road, Calcutta 9 1949, pp 44. Price Rs 3/.

This book is a comprehensive list of the "Fungi of Bengal" The workers on Mycology and Plant Pathology will warmly welcome the work as it is a very useful addition to the scanty literature on the fungal flora of India In all 700 species distributed over 248 genera of fungi and bacteria reported from undivided Bengal are recorded

The subject matter is arranged systematically and the most important feature of the book is the geographical distribution of the fungi on their respective hosts. The author s own experience in researches on Mycology and Plant Pathology has been utilized in the collection work and he has taken great care to compile the host index and the index on the genera of fungi The bibliography at the end of the book will be of value to the readers for detailed reference It is expected that mycologists in other provinces will soon bring out lists of fungi occurring in their respective areas

P N

Padarther Swarup (Constitution of Matter)—By Samar Guha Published by A Mukherjee & Co Ltd, Calcutta, 1950 Price Rs 4/-

The book represents an important effort of popularizing science in Indian language, in this case, in Bengali During the past few years there has been a marked tendency of writing popular scientific books in this country from a truly scientific point of view and not from the point of view of stunt or cheap entertainment, in which the real scientific facts and principles often inevitably suffer from distortion and misrepresentation. The author has very creditably interpreted to his uninitiated readers for whom the book is doubtless intended the scientific principles and facts which makes for an understanding of the nature and constitution of matter Starting from simple conception of atoms and molecules, the writer has told the story of electrons and their discovery, the phenomenon of radio activity, X rays, the fundamental particles like positron and neutron, transmutation of elements and artificial radioactivity and other allied developments Heisenberg s Uncertainty Principle has not also been excluded, and a few pages have been devoted to uranium fission The author ended his discussion with some cosmological problems. The language is simple and lucid The publisher must be congratulated for the fine printing and get up There is still further scope of improving some of the blocks, more particularly, their lay out in the matter itself

S. N. S.

Garden Weeds and their Control—By Stanley B Whitehead, D Sc Published by J M Dent & Sons Ltd, London Pp 150 Price 7s 6d net

This is a small hand book dealing with the various aspects of weed growth and their control Weed control is a major problem for gardeners as well as agriculturists, and this is the first hurdle to be overcome in any adventure into the realm of plant culture It has, therefore, received widespread attention in recent years This small book deals in a short, popular and impressive manner the different aspects of weed control beginning from the old classical method of mechanical eradication to that of the up to-date and improved methods by chemical substances, some of which are found to act like a plant hormone with specific reaction and in great dilutions In the text some important and commonly found weeds in gardens and grass-lawns have been described together with their methods of easy and sure eradication The get up of the book is quite handy and it will usefully serve the purpose for which it has been written. The book can safely be recommended to all lovers of gardening and allied branches

B K K.

SCIENCE AND CULTURE

A Monthly Journal of Natural and Cultural Sciences

Vol. 15 MAY 1950 No. 11

AGRICULTURAL EDUCATION AND RESEARCH IN INDIA

INTRODUCTION

THE University Education Commission appointed in 1948 by Government of India finished their deliberations by August 1949 The first volume of their report which contain their recommendations was published later in the same year About thirty years ago the Central Government appointed a Calcutta University Commission, which was presided over by the distinguished English educationist Dr Michael Sadler, and included three other British educationists associated with different aspects of university administration and teaching Sir Ashutosh Mookherji was one of the two Indian members of the Commission While the Commission was primarily appointed to make recommendations on the reorganization of the Calcutta University it was mentioned in the terms of reference 'It is possible that the Commission may for purpose of comparison, desire to study the organization and working of Universities in India other than that of Calcutta' This Commission published an extremely able and exhaustive report, and it is well known that the constitution of three of the newer Universities, established at Dacca, Allahabad and Lucknow, were influenced by their recommendations Thirty years have elapsed since then and there has been an awakening of political consciousness in the mass of the people, inspired principally by the leadership of Mahatma Gandhi The Government of India were right in thinking that the time had come to appoint another Commission 'to report on Indian University Education and suggest improvements and extensions that may be desirable to suit present and future requirements of the country'

The present Commission consisting of ten members including the *Secretary*, was presided over by the distinguished philosopher and educationist Dr Servapalli Radhakrishnan and contained seven experienced Indian University administrators, educationists and scientists One Vice Chancellor of a British University, an Emeritus President of an American University, a former president of Antioch College and first Chairman of the T A V were the remaining three members The inclusion of the two eminent Americans have enabled us to obtain an evaluation of our University educational problems from a fresh point of view In many ways the problems facing us in India are more akin to those which the U S A had to solve, rather than to those of Britain

The older American Universities were patterned on the renaissance Universities of Great Britain and Europe, with curricula for the learned professions, consisting chiefly of theology, the classics and mathematics The newer colleges and universities of the U S A, based upon endowments of land by the Federal Government to all the States of the Union by Abraham Lincoln in 1862 became known as land grant colleges' and for which the claim is made that they represent 'the most comprehensive system of scientific, technical and practical higher educations the world has ever seen' Against the West European conception of university education being confined to the elite of the population (intellectual or otherwise) there has arisen the democratic American conception, that no American youth should be debarred from taking advantage of university education on grounds of poverty and other handicaps

The aim of reforms proposed by the University Commission may be summarized as follows

> Democracy depends for its very life on a high standard of general vocational and professional education Dissemination of learning, incessant search for new knowledge unceasing effort to plumb the meaning of life, provision of professional *education to satisfy the occupational needs of our society*, are the vital tasks of higher education. Further owing to economic difficulties many young people are not getting the chance to which they are entitled and the nation is deprived of a large amount of potential leadrship in science and scholarship, industry and commerce,and means must be devised by which qualified individuals are not prevented by economic barriers from attaining the kind of education for which they are suited by their aptitudes and interests

In the present review we shall deal, in relation to its past history, the problem of rural and agricultural education as envisaged by the present University Commission. These are interrelated problems, as over 70 per cent of the population are engaged in agriculture, increased industrialisation can divert only a not very appreciable fraction of the rural population to the towns. Till very recently no serious attempt had been made to devise a system of education suited to the life of the common people, in which "education should combine practice in every day processes of living and working with more formal training". This formulation of the programme of basic education we owe to Gandhiji who "was not the first to have this vision, Aristotle, Francis Bacon, Milton, Louis Agassiz are amongst the world's great men who specifically expressed a similar conviction. While their minds caught the vision of a new day, the bookishness of their lives held some of them captive. Here is Gandhiji's pre-eminence. No sooner was a conviction matured in his mind than he acted on it."

Before considering the recommendations of the present University Commission on this subject, we propose to give a short review of the Central Government's policy since the beginning of the 19th century on agricultural education and research. This review will be divided in two parts.

Part I will deal with the period starting with Lord Curzon's Governor-Generalship to Montague-Chelmsford reforms (1903-1918).

Part II will carry the account from 1919 to 1949 when the new constitution of independent India was being promulgated.

In a subsequent issue, which will form part III of the review, we shall discuss the recommendations of the Education Commission on Agriculture and on Rural Universities, after which we shall give our evaluation of these recommendations and of the recent trend of agricultural and rural constructional activities of the centre and of non-official groups.

I. Period (1903-1918)

If we look back upon the development of higher education in this country which also influenced the trend of secondary and primary education, we find that the Universities were started in metropolitan towns and modelled on the old University of London. The products of these Universities were professional men who lived in large towns and had very little understanding of the rural problems.

The problem of agricultural education had since 1889, engaged the attention of the Government of India when Dr. Voelcker, the well known agricultural chemist visited India and advised the Government on the starting of agricultural institutions, for giving high class diplomas in four of the provinces. By 1901 there were five provincial institutions in British India, for the technical teaching of agriculture. The appointment in 1903 by Lord Curson's Government of an Inspector General of Agriculture aided by a nucleus staff of experts, marked a new departure in agricultural policy.

In 1903, the Government of India announced their intention of setting aside annually a sum of Rs. 20 lakhs, which was subsequently increased to Rs. 24 lakhs, for the development of agricultural research, experiment, demonstration and education in the provinces. It was on the strength of this grant that agricultural colleges were started by various provinces, separate departments of agriculture were constituted in most provinces and a scientific staff was entertained.

In a resolution on Government policy on agricultural education, published in March 1904, it was stated 'the existing schools and colleges have not wholly succeeded in theory or in practice. They have produced neither scientific experts nor succeeded in attracting members of the land holding classes to qualify themselves in practical agriculture. In pursuit of their plans, the Government proceeded to establish an Imperial Agricultural College and Research Institute at Pusa (Bihar), for which purpose the donation of £30,000—given in 1903 by an American Mr. Philipps, was utilized. The college was not formally opened to students till July 1908. In 1905 in a despatch to the Secretary of State the general policy of the Government was defined in greater detail, and amongst other matters it was laid down that 'in each important province an agricultural college with a research station, adequately equipped with class rooms and laboratories should be established to which was to be attached a farm of suitable size. The Government of India hoped that what Pusa was to be for the whole of the Indian Empire, the agricultural colleges and research stations of the several provinces would be on a smaller scale for the provinces themselves.' Further on, it was stated that 'the Government desired that provincial colleges should teach upto a three years course and that the men who had shown most aptitude should be drafted to Pusa for a further two years post graduate study, and in that way they hoped gradually to arrange in India for the recruitment of agricultural specialists." The provincial colleges were planned to attract as far as possible students who had been brought up on the land, and to turn out practical men with general knowledge of agriculture and agriculatural science, to fit them for the subordinate posts in the agricultural departments and for employment as managers of Court of Wards and private estates. By 1918, Colleges of Agriculture were established at Poona, Kanpur, Lyallpur, Coimbatore, Nagpur and Sabour. The last mentioned college was intended to serve the requirements of Bengal, Bihar and Orissa. Some of the colleges only granted diplomas and the others were affiliated to their provincial universities. The Pusa Institute developed its research side at the expense of its teaching function. Some of the distinguished members of its staff, in reply to a questionnaire sent out by the Sadler Commission, expressed the view that agricultural research should be entirely divorced from agricultural teaching, the former should be concentrated at Pusa, and the provincial colleges should be debarred from carrying out research. These scientists were isolated in the expression of such views.

There were reports of failure of the agricultural colleges in some of the provinces to fulfil the purpose for which they were started The Public Service Commission of 1917 did not appear to have been discouraged by the existing state of the provincial colleges They recommended, in support of the Government resolution of 1905, that the staff and equipment of each provincial college should be maintained on a scale adequate not only for the instruction of the students but also for effective prosecution of research It should be recognized that a great deal of research work in India can best be accomplished in the provincial centres where conditions of climate and soil are suitable The development of provincial research work and experiment should be encouraged and such work should not be regarded as necessarily of less importance than the work which is being carried out at Pusa Each college should be regarded as an integral factor in the scientific development of the industry on which the prosperity of India mainly depend These wise words were not given adequate consideration in the later development of agricultural policy of the Government of India subsequent to the constitutional changes introduced in 1919 when agriculture became a transferred subject We shall have occasion to refer to this matter later

The questionnaire sent out by the Sadler Commission brought some valuable suggestions regarding the role of Universities in the furtherance of applied biological teaching and research The late Sir Edwin Butler, who was the Imperial Mycologist at the time urged that the university would be more useful to workers in applied science if it takes a broad view of pure science as the foundation on which all utilitarian progress must be based before its resources are further pledged for the direction of technological studies He strongly urged that the University should devote its attention to tropical biology then comparatively little studied in Indian Universities and special attention should be given to the study of subjects like Plant Physiology, Cryptogamic Botany Entomology etc Similar views were expressed by Mrs Howard and F M Howlett (Entomologist) *viz* what is required in India is not training in general agriculture but the education of specialists in various sciences on which agriculture is based

Coming back to the question of general agricultural education, several conferences were held during 1916 and 1917 The questions on which the conferences were invited to express their opinion were

1 Should the *objective of* agricultural colleges be merely the provision of suitable candidates for serving in the Agricultural Department or should they aim at providing liberal and scientific education in agriculture which should be as complete as possible and would attract not only students who aspire to the higher posts in the Agricultural Department but others who wish to take up higher studies and research for their own sake

2 Would it be possible to combine both these aims, and if so would it be an advantage if the colleges were affiliated to the different universities

3

4 Is it desirable that any instruction in the vernacular should be given at the agricultural colleges, either in the form of two years course referred to in (3) or in that of short vernacular course outside the ordinary college courses intended for the sons of Zamindars and others farming their own lands ?

The recommendations of the conferences have been summarized in the Sadler Report as follows

(a) The direct instructions of the persons engaged in agriculture must for the present be given by means of and in connection with demonstration farms That teaching will probably create a demand for definitely agricultural schools and if such schools are started it will be necessary to supply them with teachers In the meantime a small number of middle agricultural schools should be started Thus agricultural colleges will not be required in the near future to produce any large number of trained teachers

b) Whatever expenditure may be undertaken in connection with general rural or definitely agricultural education there should be no resulting diminution in or limitation of the funds of staff that are necessary for the maintenance and progressive development of the research and demonstration work of the Agricultural Department

(c) The development of agricultural colleges in the various provinces is desirable but the development of these colleges and their relationship with local universities must depend on local conditions

Regarding the success or otherwise of the agricultural colleges started in the different provinces opinions varied From Madras came the report (1907-1912) that the college at Coimbatore was more successful in obtaining a large proportion of students of the desired class about half being the sons of land owners whose object was to acquire a knowledge of practical farming which will enable them to manage their farm to better advantage The popularity of the college at Lyallpur is attributed to two main reasons 'the first is that the college now leads on to a definite well paid career in the Government service, also the land owning classes realize that a training at the college will render their sons more fit to manage their estates than would have been the case otherwise and that the possibilities of improved agricultural methods are not small in the Punjab There is evidence that the college at Kanpur had also served its purpose On the other hand the Sadler Commission records that it is difficult to believe that Sabour has been a successful training ground for Bengali students The number of Bengali students attending the Sabour College during the period 1912 1918 fluctuated between 2 to 11, against a maximum permissible number of annual admission of *20* from Bengal A considerable portion of the trained students obtained Government service

The Sadler Commission collected a large amount of evidence to find out why in Bengal with the largest number of permanently settled land agricultural education had been so unsuccessful in attracting the sons of land owners They expressed the view that "the methods of cultivation and of land tenure prevalent in Bengal do not lend themselves to any considerable employment of highly qualified scientific experts, such as university graduates in agriculture ought to be The kind of training for which there is a wide spread need is of a more elementary kind which may be introduced as an element in some intermediate colleges There is need for a limited number of highly trained men and it is the duty of the University to provide for them" The Calcutta University has been toying during the last thirty years with this question but with very little tangible results We are of opinion that a metropolitan University controlled by men of the generally called learned professions can neither understand the problem of agricultural education, nor make adequate provision for its teaching The agricultural colleges at Lyallpur and Coimbatore which have functioned successfully are situated in the heart of agricultural districts and are attached to large Government agricultural experiment stations, other factors besides geographic location may have contributed to the success of the institutions

To sum up , the progress in agricultural education and research during the period 1902 1918 included (i) establishment of a Central Agricultural Research Institute and College at Pusa, where provision was made for the post graduate training to selected graduates from provincial agricultural colleges A fair amount of work in plant breeding mycology, and entomology were undertaken chiefly by British scientists who manned the superior services , (ii) establishment of provincial agricultural experiment stations to some of which agricultural colleges were attached The colleges provided training ground for a limited number of graduates most of whom were absorbed in Government services , only a few belonging to the land owning classes utilized their training for improving the productivity of their farms Some of the experiment stations provided opportunity for agricultural research to men like Hector, Finlow, Mann Barbour and others, (iii) though there was a large number of conferences held, no serious attempt was made to introduce agriculture as a subject for instruction in village schools , (iv) in several Indian universities graduate and post graduate courses in biological sciences were introduced as well as facilities provided for research in these subjects Thus opportunities became available for the training of specialists who took an important part in the advancement of applied biological researches in the post Montague Chelmsford reform period This expansion of university activities was along the lines suggested by E J Butler

II PERIOD (1919-1949)

It was mentioned in the previous section that as a result of constitutional changes of 1919, the Government of India divested themselves, except to a very limited extent, of all powers of superintendence, direction, and control over 'transferred' subjects' which included agriculture and veterinary subjects

The administration of Central agencies and institutions for research and for professional and technical training, were retained as Central subjects, but no specific provision had been made for coordinating the work in this respect with that of similar institutions in the provinces The consequences of the transfer of power to the provinces so far as agriculture is concerned has not been satisfactory While some of the provinces continued to progress, others like Bengal lagged behind deplorably; there is need for a Central authority to insure some uniformity in standards of education, research and development in agriculture The experiment of sending students from Bengal to the the agricultural institute at Sabour did not prove successful and the College was closed in 1921 Proposals were made to start an agricultural degree course in the newly founded Dacca University, in collaboration with the Government Agricultural Station at Tejgaon the scheme did not materialise till 1939 At this time an agricultural institute was started by the Hindu Academy, Daulatpur Both the institutions were lost to West Bengal as a result of the recent partition of the provinces in 1947 Due to the initiative of Mr R G Casey then Governor of Bengal a large modern and expensive livestock farm was started during the last war years at Haringhatta over which we understand a crore or more of rupees has already been spent After partition plans were discussed of making Haringhatta the central agricultural station of West Bengal and to attach an agricultural college to it The estimates for capital and recurring expenditure were found to be so prohibitive that the Government has kept the proposals in abeyance and West Bengal is without an agricultural college Under similar conditions the other partitioned province of East Panjab has started in 1947 an agricultural college at Amritsar, attached to the Khalsa College The Government of Panjab (I) evidently did not wait for the construction in a wilderness of a modern college of agriculture, based upon the specifications of the Central College of Agriculture in Delhi, but started with the materials which were available immediately On the other hand in West Bengal, the proposed college of agriculture was planned for erection in a non inhabited locality where an excessive cost would be entailed for construction of laboratory buildings, residential quarters, experimental farms etc

It is an anomaly that while the Central Government is fully alive to its responsibility for initiating and financing schemes for establishment of National Laboratories (eleven in number), regional Technological Institutes (four in number) and for providing capital and recurring grants for enlargement of equipment and of teaching staff of provincial engineering colleges, and of the Applied Science departments of provincial Universities, no similar efforts are being made to lay down long range plans for agricultural research, education and development One has only to compare the budgets of the Council of Scientific and Industrial Research, of the Atomic Energy Commission and of the Department of Scientific Research, with those of the Indian Agricultural Research Council, of the Research Institutes and of the associated Commodity Committees, all under the Ministry of Agriculture These last named organisations had a longer start, but we miss in them the stamp of a personality endowed with vision and purpose The Ministry of Agriculture appear to be so engrossed in carrying out their short term plan of compaign for growing more food, and thereby saving foreign exchange used up in the import of food from abroad that long range problems of the reorganisation of the departments of the ministry and the enlargement of their functions have escaped their attention It is time that considerations were given to them

Difficulties of the Agricultural Problem At the same time we have to recognize that certain agricultural traditions based upon thousands of years of practice have accumulated in India Dr Voelcker wrote in 1889 'Certain it is that I at least have never seen a more perfect picture of careful cultivation combined with hard labour and fertility of resource than I have seen at many of the halting places in my tour Mr G M Howelett in a letter to a member of the Sadler Commission wrote There is a notable amount of truth in the saying that agriculture is an art based upon sciences The Indian cultivator has the art and we are now realizing that it is our business to supply a sounder basis of sciences than the (by no means inefficient) traditional system which is at present the guide Round this traditional system century long social customs and economic practices have accumulated which are seriously restricting the productivity of the land Some of these are considered below

A (i) The existing system of land holding in which side by side in different parts of the country permanent and temporary settlements and the *ryotwary* system prevail

There is a growing demand for the abolition of the big Zamindaris and of the crop sharing system The ideal aimed at is the distribution of the land to the actual cultivators under a *ryotwary* system which will give the cultivators a greater incentive for increased production

(ii) The uneconomic size of holdings due (a) subdivision and (b) to fragmentation

(a) The Famine Commission of 1944 had collected statistics on the average size of holdings and yield per acre of land in the different provinces from which we take the following figures

Province	Average size of plate	Yield per acre of cereal crop in ton
Bengal	4 4	0 48
United Provinces	6 0	0 348
Madras	4 5	0 412
Panjab	10 0	0 34
Bombay	11 7	0 189

In all the provinces enquiries have revealed a progressive increase in the number of small holdings The immediate cause of the tendency to progressive diminution in the size of the holdings is subdivision *i e*, distribution of land of a common ancestor amongst his successors-in interest usually in accordance with the laws of inheritance It is generally agreed that the primary cause of this tendency is the pressure of population The suggested remedies are first the bringing of additional land under cultivation and secondly an increase in industrial employment The other measure which has been suggested would require the modification of the laws of inheritance On this subject the Royal Commission on Agriculture in India (1928) observed no practical suggestion was put forward for the prevention of further subdivision without interfering with the laws of inheritance There was also no unanimity in opinion on this point amongst the members of the Famine Commission of 1944 The majority were of opinion that from the point of view of productive efficiency larger and moderate sized holdings are preferable to small holdings (they) do not feel justified in recommending a change in the laws of succession which it is agreed will be strongly opposed by public opinion

(b) The other problem which also requires serious consideration is that of fragmentation of holdings in which the land held by an individual (or undivided family) is scattered throughout the villages in plots separated by land in possession of others In certain provinces legislations (prior to 1944) has been enacted for the consolidation of holdings and it is desirable that similar legislations are introduced in other provinces

(iii) If the present trend for the breaking up of large estates and the distribution of land amongst the cultivators is accomplished the question will crop up whether in the interest of increasing the efficiency of crop production in an already over populated country some form of collective farming either on voluntary cooperative basis or by legislative compulsion, may be necessary In several countries besides Russia collective farming has been or is being introduced The problem has to be faced in this country also and it will not do like the Radhakrishnan Commission to take refuge in expression of pious opinion The problem of food production in India must be solved by means which are in harmony with the fundamental principles of freedom democracy equality fraternity which are the pillars on which the structure of the new Indian society is being built

B Besides the introduction of necessary legislation for the remedy of the economic and social factors hampering agricultural production and their implementation certain ameliorative measures through State agencies are also necessary Some of these are indicated here These are chiefly of agricultural engineering nature *viz* reclamation of waste land control of soil erosion by afforestation and other methods Supply of water for irrigation and of rural electricity these two come under what is known as multipurpose river training schemes And lastly manufacture of inorganic fertilizers All of these measures have been taken up by Central and State agencies with great energy perhapes there has been some lack of planning and fixing of priorities in the multitude of schemes which were put up The time which will be taken for the completion of these schemes and the efficiency of their utilisation will chiefly depend on the availability of capital and on the develop ment of the know how in our technically trained staff

It is in relation to such social economic and technological back grounds that we shall have to plan our future schemes of agricultural education research and development Also in relation to this back ground we shall review the events occurring during 1919 1949

Rural and higher agricultural education—Over eighty percent of the people of this country live in about half a million of villages their principal occupations are agriculture and village crafts centred round the latter Rural education must therefore centre round agriculture and the allied crafts

A new departure in the solution of the gigantic problem of universal primary education was proposed by Gandhiji in 1935 in a scheme called Rural national education through village handicrafts

These proposals were considered in October of the same year at a conference convened at Wardha and certain resolutions were adopted of which the following are of interest to us The process of education throughout the primary stage of seven years should centre round some form of manual and productive work and that it is expected this system of education will gradually be able to cover the remuneration of teachers This craft centred basic education it has been explained in answer to criticisms is not primarily for the production of craftsmen able to practise some craft mechanically but rather for the exploitation for educative purposes the resources implicit in craft work In spite of several drawbacks the scheme has for the first time in this country attempted to impart formal education to children in rural areas in terms of activities and interests with which they are familiar Regarding the other aim of making education self supporting it is now considered sufficient that the articles the children will produce are marketable and that if it is not self supporting in any sense it should be accepted as a sound educational policy

In 1937 when congressmen agreed to form the ministry in some of the provinces the scheme was launched under official patronage in C P U P Bihar Bombay and Orissa But unfortunately in 1940 even before the scheme had been fully established as an experimental measure the congress ministries resigned office and the Government patronage which basic education enjoyed was withdrawn After August 1947, the basic education training centres have been re established in most of the provinces but we have no report on any comparative achievements of pupils in basic schools and in ordinary primary schools An interesting innovation was sponsored by the C P Congress Government in their Vidyamandir scheme whose importance lay in the suggestion it made for the organisation and maintenance of a compulsory primary school system The Vidyamandir scheme suggested that in every village sufficient land would be set apart for the maintenance of the village primary school Thus the school instead of depending on grants from provincial exchequer would be a part of the village economy and be maintained as such

It was on a similar principle that Abraham Lincoln made in 1862 grant of federal lands to the different States of the U S A for the endowment of State colleges (Landgrant Colleges) which as we shall see later played such an important role in the development of agricultural and technological college education in that country

The ideas underlying the Wardha scheme was incorporated in the report of the Central Advisory Board of Education for the post war educational reconstruction of this country which is commonly known as the Sargent plan It presents a comprehensive plan of educational reconstruction from top to bottom in fact the first complete Government scheme for providing India with a national system of education

Secondary schools according to this plan will be of several types In the technical high schools to be established in rural areas where pupils are likely to take up agriculture on their own farms or elsewhere an agricultural bias is to be given to the curriculum The proponents of the plan have no clear conception of what rural secondary education should be In the memorandum drawn up by the Indian Council for Agricultural Research it is suggested that such vocational agricultural schools can serve a useful purpose as an intermediate stage in the training of agricultural demonstrators and also for the training of village guides We have no information how many vocational agricultural secondary schools have been established and how far the training provided serve the needs of agriculture

The Radhakrishnan Commission Report gives a list of twenty one institutions for higher agricultural education including the three All India Institutes for Agricultural Dairy and Veterinary Research which offer post graduate diploma courses It is interesting to note that during the period 1941 1949 13 new Agricultural Colleges have been started including the conversion of the institutes at Poona and Sabour to colleges affiliated to their respective provincial universities We also find that while in 1924 there were only two colleges which admitted 30(82) students in 1949 there were 17 colleges which admitted 1448(3261) students The figures inside brackets represent the number of applicants It was reported to the Commission by the heads of these institutions that of those who do graduate not more than two to three per cent return to agricultural communities Previously in 1937 Sir John Russel had remarked that the man who actually tills the soil is scarcely touched by the national programme of agricultural education The cases where the influence of agricultural research has been felt are largely those in which industry has directly impinged on agriculture so that the techanical demands of industry could impress themselves on agricultural practice

Research and Development—A new departure in agricultural policy was we have seen initiated by the Government of India in 1903, commencing with the appointment of an Inspector General of Agriculture aided by the nucleus of an expert staff This was followed by the establishment of an Imperial Agricultural College and Research Institute Pusa and the formulation of a new policy of agricultural education and research both at the centre and in the provinces Since the introduction of the new constitution there had been no review of the agricultural policy in 1928 a Royal Commission on Agriculture presided over by Lord Linlithgow was appointed to examine and report on the condition of agriculture and rural economy in India The Commission remarked that inspite of the marked progress which has been made in many direction during the last quarter of a century it is hardly an exaggeration to say that agricultural research in this country is still in its infancy They thought that however efficient the organization which was built up for demonstration and propaganda unless the latter was put on the solid foundations based upon research it was merely a house built on sand Acting on their recommendations the Government of India established in 1929 an Indian Council of Agricultural Research (I C A R) Its principal objective was to undertake coordinate and promote agricultural and animal husbandry education research and its application in practice development and marketing in India by all means calculated to increase scientific knowledge of the subjects and secure its adoption in every day practice There is a Governing Body of the Council which is assisted by an Advisory Board The Council sets up from time to time certain standing or ad hoc committees of the Advisory Board as well as of the Governing Body for examining all proposals in connection with the scientific objects of the Council which might be submitted to the Governing Body to report on their feasibility and to advise on any other questions referred to it by the Governing Body The Minister in Charge of Agriculture is now the ex officio Chairman of the Council and of its Governing Body The executive functions of the Council are administered by a whole time Vice Chairman who has the status of a Secretary , he is assisted by two whole time experts designated as Agricultural and Animal Husbandry Commissioners and by a staff of permanent officials

Research and development activities under the Ministry of Agriculture are undertaken roughly by three classes of agencies

A—Institutes directly under the Ministry of Agriculture in which general problems of plant and animal husbandry are investigated. These include (i) The Indian Agricultural Research Institute which was removed to New Pusa Delhi from Pusa after the Bihar earthquake of 1934 The Institute has the following departments General Agriculture Cattle Breeding Agricultural Chemistry Economic Botany, Mycology and Entomology Special experiment stations have been started for carrying on breeding work on wheat, potato, sugarcane (Coimbatore) Where the work on any one of these agricultural crop increases sufficiently, a special all India Institute is started for its furtherance Recent examples of such institutes are (a) Rice (Cuttack), (b) Potato (Patna) It is proposed to start other institutes of a similar character for the study of other plant and animal products

(ii) Indian Veterinary Research Institute at Izatnagar and Mukteswar At the former place there are sections on Biological Products Animal Nutrition Poultry Veterinary Zoology Animal Genetics etc while at Mukteswar there are sections on Pathology and Bacteriology Veterinary Zoology etc

(iii) Indian Dairy Research Institute now located at Bangalore with sections on Dairy Husbandry Technology Chemistry and Bacteriology

All the All India institutes provide post graduate diploma courses

B—*Commodity Committees* There are a number of cash crops whose products are either exported or can form raw materials for industry Research on agricultural productions and on technological utilization of these commodities are financed by means of cess levied on them Central committees are formed for each of these commodities on which growers industrialists and exporters are represented At present there are Central Committees on Cotton Lac Jute Sugarcane Coconut Tobacco and Oilseeds

C—Functions of the ICAR are broadly speaking the following

(i) To foster agricultural research chiefly through non Governmental agencies like Universities and Research Institutes by means of grants in aids At the same time special research projects sponsored by different provincial agricultural and veterinary departments or by All India Institutes are given grants in aid under special conditions

(ii) The council has also the responsibility of co ordinating agricultural researches in Government Institutes non Government agencies like Universities and Research Institutes and by commodity research committees

(iii) The coordination of the activities of the Commodity Committees with those of the other research agencies is principally through the Vice Chairman of the ICAR who is the ex officio Chairman of all the Commodity Committees

The Commodity Committees besides having their own technological and central experiment stations can also have regional experiment stations in different parts of the country to ascertain the most suitable varietal and manuring practices for each tract The Committee can have its own staff for propaganda and inspection Instances are not unknown where the provincial agricultural departments have claimed that the latter should be under their control for minimizing over lapping and friction

Decennial Review of the activities of the ICAR ı was undertaken by Sir John Russel and Dr G N Wright two well known experts from England They reported that while a good deal of useful research work had been carried out by the Council the improvements effected had not been taken up by the cultivators and that it has become necessary to bridge the gap between the laboratory and experiment station on the one hand, and the cultivators field on the other This implied development or extension work which was primarily the function not of the Research Council but of the provincial Departments of Agriculture Nevertheless it was felt that the Council could not divest itself completely of the responsibility and that it should therefore take steps to help the provinces and States in bringing the fruits of research to the doors of the cultivators The Memorandum of the Assosiation of the ICAR has been modified so as to include development research by which the research worker is enabled to try his experimental findings on a field scale

We shall in a subsequent issue review the activities of the Agricultural Department both at the Centre and in the provinces along with the recommendation of the University Commission on Agricultural Education and Rural Universities

Non official rural reconstruction organisations—We can not close this portion of the review without giving a short account of the part played by such agencies in furtherance of rural reconstruction and also of an agro industry organisation which is a type of industrial undertaking—not cottage industry— which is specially suitable for development in rural areas

Rural reconstruction centres—The pioneer institute in this direction is probably the Institute for Rural Reconstruction of the Visva Bharati inaugurated by Rabindra Nath Tagore in 1921 Similar centres have also been started by many missionary organizations The most important of such organizations are the All India Village Industries Association and the All India Spinners Association These bodies have amongst their objectives the improvement of rural agriculture and dairy industry introduction of new rural industries and improvement of existing ones they arrange for the distribution of raw materials for handicrafts and seek to improve the marketing of the products Such organizations when staffed by energetic workers have achieved considerable success particularly if sufficient funds are available to facilitate the initiation and development of the work There is always the danger however that on the departure of these who provided the necessary driving force and the withdrawal of funds the ground which has been gained will be lost This shows that the conditions necessary for the self maintenance of these industries in the villages have not yet ben achieved

Agro industry—The working of an estate named Walchandnagar in the Bombay presidency has been described in some detail in the Report of the Famine Commission (1944) for the reason that it brings out prominently the essential elements in a programme of combining development of agriculture and rural industry to which we attach considerable importance Where the factory is located close to the farm and both are managed in organic relation to one another it is clear that the development of the factory helps the development of the farm and *vice versa* The general lesson we would draw from this instance of the combined development of agriculture and industry is the benefit which would accrue from the establishment in rural areas of factories for the processing of farm products and working in assosciation with large holders of land and with cooperative societies representative of small holders In this particular instance the estate which covers 45 square miles was formed about 12 years ago (1932 33) by the acquistion or lease of land belonging to numerous small holders and has been developed primarily as a sugar cane farm Large areas of salt affected waste land has been reclaimed and irrigation has been extended During 12 years the area under sugar cane cultivation has gone up from 1000 to 3500 acres and the yeild per acre gone up from 35 tons to 53 tons per acre i e an increase of 50 percent

The area under food crops has been increased and recently cultivation of vegetable on a considerable scale has been developed A sugar factory has been started along with it an oil mill has been established and the groundnut cake produced by the mill is used on the farm as manure An oil refining and an oil hydrogenation plant treating of the raw oil has been started It is reported that the volume of employment has increased that better wages are being paid than in similar employment in the neighbourhood and that in particular new avenues of employment have been developed for skilled personnel

This is a very good example of how agro industries can be started in rural areas The particular one is due to the initiative organizing ability and vision of one industrial magnate Whether such organizations can be started in rural areas by cooperative societies under government supervision is a problem which urgently requires trial in different parts of the country

RECENT COSMIC RAY EVIDENCE ON THE PERMANENT SOLAR MAGNETIC FIELD

M. S. SINHA
BOSE INSTITUTE, CALCUTTA

IT is well known that the increase in intensity of Cosmic rays with latitude extends only upto a latitude of 50° N both at sea level and at high altitudes. The experiments of Bowen, Millikan and Neher[1] and those of Carmichael and Dymond[2] at latitudes 60° N and 85° N respectively indicate that there is no appreciable increase in intensity at high altitudes for these two different latitudes. The highest altitudes reached in these experiments were about 28 kilometers.

In order to explain the absence of the latitude effect above 50°N Janossy[3] first put forward the suggestion that there should be a sharp cut off in the primary energy spectrum at the low energy end since the primary intensity cannot contain particles which are latitude sensitive above 50°N. The necessary cut off energy was easily calculated and found to be at 3×10^9 ev. This cut off was attributed by Janossy to a permanent magnetic field of the sun whose value on the surface of the sun was estimated to be about 100 times that existing on the earth's surface; there is however little evidence for such a large solar magnetic field from other sources[4]. But the sharp cut off postulated above received support from another very different set of experiments. The position of *the maximum* in the height intensity curves at the above latitudes is fairly well established and confirmed by a number of investigators. Assuming an inverse cube power law for the primary spectrum, it can be shown from the Cascade theory that the observed position of the maximum in the height intensity curve can be explained if there is a sharp cut off of the primary spectrum at about 2×10^9 ev. This position of the cut off is in good agreement with that previously deduced from the geomagnetic effect.

Recently Dr. M. A. Pomerantz[5] of the Bartol Foundation has reported on some new free balloon flight investigations carried out in Canada in collaboration with the Defense Research Council of Canada. The balloons carried a four fold coincidence arrangement of Geiger Counters. Each time a cosmic ray particle tranversed the four counters in a certain direction a signal was produced and relayed to a mobile laboratory on the ground. Continuous information was also transmitted regarding atmospheric pressure and temperature. The heights attained by the balloons varied from 100,000 to 110,000 ft (approximately 41 kilometres), the zone representing the outermost one per cent of the earth's atmosphere.

The experiment was carried out at Manitoba (Geomagnetic latitude 69°N) and at Swarthmore (Geomagnetic latitude 52°N). Dr. Pomerantz finds a considerable primary intensity below 10^8 ev at these heights which means that the cut-off in the primary spectrum, if it exists at all, is below 10^8 ev. Thus the solar magnetic field does not impose a cut off as previously estimated. The value of the latter according to Dr. Pomerantz could not be greater than one twentieth of the value predicted previously from geomagnetic effects and consequently the value of a permanent solar magnetic field can be at most one twentieth of the value ascribed to it from the previous results.

This however leads to a contradiction with the requirement of the height intensity curves which can be explained only on the assumption of a sharp cut off at 2×10^9 ev. Dr. Pomerantz says that since the results of the Cascade theory have been confirmed in other experiments the assumption of an inverse cube power law for the primary energy spectrum must be incorrect. Hence the presence of low energy primaries of the order of 10^8 ev detected by Pomerantz at the top of the atmosphere leads to the conclusion that the differential energy spectrum does not follow the inverse cube power law at least in the low energy region.

This effect has however nothing to do with the large variations in local magnetic intensities in the sun which accompany sun spot activities. The instruments sent in the balloons by Dr. Pomerantz contained among various other improvements a new type of altitude recorder and a device by which the Geiger Counters could be kept at ordinary temperatures even though the balloons reached temperatures 60°F below zero.

The existence of a permanent solar magnetic field of the usually accepted value has been questioned by Dolbear and Elliot[6] on the basis of certain cosmic ray investigations recently carried out by them. The presence of such a field will produce not only a latitude cut off but also a daily variation in the cosmic ray intensity as the earth rotates relative to directions which are forbidden by solar fields. This amplitude variation should increase with altitude since the contribution to the cosmic ray intensity increases with height. Rossi estimated that this daily variation should be as much as 30 per cent at 35,000 ft at a latitude of 48.7°, and concluded that this was not in agreement with observations.

More recent calculations have shown that the daily variation should be much smaller. For the latitude of the centre of England and altitude of about 30,000 ft Dolbear and Elliot calculated that the difference in day and night intensities should be on an assumed value of solar magnetic field of 38 gauss at the equator about 3.5 per cent. They measured the cosmic rays intensity with a counter telescope carried on an aircraft at mean elevation of about 30,200 ft over the middle of England. The flights were centred at 00 h 42 min and 14h 45 min and the difference (day minus night) came to—0 12±0 83 per cent, i e, the calculated amount differed from the measured value by 4 4 times the standard deviation The authors conclude that it seems unlikely on the basis of the present theory, that the so called latitude cut off at 50° can be due to the sun's magnetic field

REFERENCES

[1] Bowen, Millikan and Neher *Phys Rev*, *53*, 885, 1938
[2] Carmichael and Dymond *Proc Roy, Soc* A, *171*, 321, 1929
[3] Janossy *Z Phys*, *104*, 430, 1937
[4] Chapman *Month Not Roy A Soc*, *89*, 59, 1928
[5] Pomerantz *Jour Frank Inst*, *249*, 105, 1950
[6] Dolbear and Elliot *Nature*, *165*, 353, 1950

WOOD AS RAW MATERIAL OF INDUSTRY*

S KRISHNA

FOREST RESEARCH INSTITUTE, DEHRADUN

WE meet this evening to pay tribute to the memory of Prof H K Sen By founding this series of lectures you will perpetuate the name of one whose life was a record of distinguished service to Chemistry and to the Country Sen was a man who never spared himself in his efforts to awaken our countrymen to the importance of applied science His task was difficult but noble Unfortunately, he did not live long enough to see the realization of some of his labours

Looking at the published work of Prof Sen one is amazed at the versatility of his talents Starting as a pure organic chemist he entered into more promising field of biochemistry, and again from fermentation chemistry to the chemistry of fuels, gaseous explosions, high pressure reactions, gasification of water hyacinth and sources of power alcohol Later he directed his attention to resins, lac, plastics and a host of other problems In the latter part of his distinguished career he devoted considerable attention to low temperature carbonization of coal and many other subjects of industrial importance to this country During my frequent meetings with him at Calcutta and Ranchi, we often had long discussions on conservation of wood and timber by proper utilization, and also on the possibilities, in India, of the saccharification of wood for the production of power alcohol This coupled with his interest in resins, lac, adhesives, and the industrial utilization of forest products has encouraged me to select "Wood—an ancient, yet new, raw material of industry" as the subject of my address this evening

Wood is one of the greatest gifts of nature to man It must have been one of the first materials to be used by him, ever since his appearance on earth, be it for nothing else than as a weapon for defence against animals. As man progressed he found newer uses for it, primarily as a material for making fire for warmth and cooking, and later as a material for making his home These uses still remain the primary uses of wood, especially in agricultural countries whose economic condition is low Be it for his hut or farm implements, wood plays an important role in the economic life of a villager Nature has been generous to man by providing him in wood such an excellent constructional material generous to insect and fungus life by providing in wood their food and shelter While seeking food and shelter these lower forms of life bring about the destruction of wood, and the loss caused by them in terms of money, time, and labour is inestimable This consequently puts a limit to what might have been an inexhaustible supply, and there is no method known by which wood can be made to last for ever Advocates of cement, metal, and plastics would have us believe that the day of wooden buildings, wooden furniture, wooden sleepers, poles, and the like has almost reached its end, and that the modern world will cease to use wood for these purposes Undoubtedly cement and metals have replaced wood in many directions, but not entirely Weight for weight wood, irrespective of the species, is as strong as steel and about six times as strong as cement This fact unfortunately has not been fully realized by the engineers, with the result that they have given undue importance to steel and cement This myth is slowly breaking up, and the fact that in many countries large percentage of highway bridges, including railway bridges, are made of common woods is a testimony to the strength and performance of timber One of the most common objection against the extensive use of timber for structural purposes is based on a popular conception that timber buildings are more susceptible to fire hazard than those built of cement and steel Wood no doubt is combustible, but it does not follow that wooden buildings are not as safe as those built of cement and steel It has long been accepted, even by steel and cement enthusiasts, that properly designed timber construction takes more time to collapse when on fire than unprotected steel ones, which warps and bends rapidly under heat and allows the roofs and walls to cave in and collapse. No wonder, therefore, that the famous insurance firm of Llyod's of London now insure timber buildings at the same rate as those for cement and steel India is fortunate in having very strong structural timber like sal (*Shorea robusta*), asna (*Terminalia tomentosa*), baliga (*Peocilonenron indicum*) and others which are 50 to 150 percent stronger than the standard structural woods of Europe and America

The use of wood for certain purposes may decline, but new uses or increased use for other purposes appear always to make up for this. In point of fact we are using more wood, or at any rate felling more, than we ever did before in the history of mankind. At present no less than 500 million cubic meter of wood is cut every year all over the world for use by the wood using industries. Nature has been generous in providing wood of infinite variety, weight strength and performance. We have feather weight woods like balsa (*Ochroma lagopus*, sp. gr. 0.125) and woods like black iron wood of S. America (*Krugiodendron ferreum* sp. gr. 1.3) that sinks in water, and a whole range in between these two extremes. Compare these with metals used in construction *viz.*, steel (sp. gr. 7 to 7.9) copper (sp. gr. 8.94), aluminium (sp. gr. 2.58). The range offered by wood is not available in these metals. Strength for strength, wood is the lightest and cheapest of the building materials. The general availability and variety of wood, its lightness and ease of fabrication by simple and inexpensive tools at small plants and on the farm its numerous other advantages and the many purposes it serves will keep it in demand on an increasing scale for ever, provided of course it can be made to last longer than it normally does. Protection of wood against insects, fungi, as also against losses through fire weathering and mechanical wear is therefore vital to the economy of our country. The rediscovery that wood is the most economical and practical material for varied uses has already brought in a change in its favour. The two great factors which have helped this change are that wood can now be made more durable and that new ideas in the economy of wood have been developed.

---

*Full text of H K Sen Memorial Lecture delivered at the Bose Research Institute, Calcutta on 15 3 1950

The question of making wood last long is not new. Throughout the ages man has attempted and practised it. He came to learn that heartwood is more resistant to decay and insect attack than sapwood which in the untreated state, gets quickly destroyed by termites and /or fungi especially in a tropical country. Unfortunately heartwood of every species of wood is not endowed with this natural resistance. Examination of some 200 species of common Indian timbers indicate that they can be divided roughly into 5 classes, depending on the natural resistance of their heartwood to termite and fungi attack. While heartwood, as a rule is more resistant to fungus and insect attack it is also more resistant to preservative treatment. Sapwood, on the other hand, can easily be treated with preservative chemicals. What brings about the natural resistance of wood to insect and/or fungus attack is not known. The physical characteristics of wood do not appear to be responsible for this. Indications, however, are available that this property is possibly due to chemicals deposited in such wood. It would be worth for the chemists to investigate the substances which make teak and some other woods proof to termite attacks.

Timber which is resistant to insects and/or fungi may not also be resistant to marine borers. The only Indian timber which is said to be resistant is *Artocarpus gomiziana* Wall from the Andamans. The natural resistance to marine borers is attributed to the silica content. How far this is correct requires further investigation.

It has been stated earlier that the loss caused to wood by insects and/or fungi is inestimable. Some idea of this may be had from the wooden railway sleepers which are required to replace the damaged ones. We have about 34,000 miles of railway track half of which is on wooden sleepers and for replacement 4,000,000 sleepers were used in 1945 and about six millions in 1948 costing no less than Rs. 50,000,000. Untreated sleepers are not expected to give service for more than 6-12 years depending upon the species of wood and locality. Sleepers treated with wood preservatives on the other hand give almost double the life (12-20 years) thus reducing the annual replacement cost by less than half. Hitherto we had been limited to using only those woods for railway sleepers, such as teak sal, and deodar that are naturally resistant to attack by insects and other lower forms of life, but with the development of technique and chemicals, even lighter and cheaper woods could now be used, if properly treated. This to a country like India is of great importance and significance because our stocks of teak and sal are limited. In 1920 the average renewal of sleepers on all railways was 12 to 15 per cent, but in recent years this has been reduced to 5 to 6 per cent. This is when our capacity of creosoting plants for sleepers is limited, but it is hoped that it will soon be increased to nearly 5 million cubic feet. As a result it would be possible to make use of at least 30 species of Indian timbers for railway sleepers, in place of about 6 which have hitherto been regarded suitable for the purpose. This may be considered a great advance on our economy in wood. The science and art of wood preservation have been so developed that practically any timber which is not durable in its natural state can be made to last for an almost indefinite period in inside and for at least 20 years in outside locations.

An examination of the results of experiments with treated sleepers also indicates that in most cases their removal from the track is due to mechanical wear. Any method of increasing the mechanical life of sleepers therefore deserves consideration. Our answer to this is the production of composite sleepers, a 'sandwich' type of structure in which inferior timbers are used for the core and more durable ones for the outside, with suitable bearing plate glued on.

In India, not much of the timber used for building purposes is chemically treated. With the shortage of building materials of all kinds and limited supplies of the naturally durable woods like sal (*Shorea robusta*) and teak (*Tectona grandis*) it is expected that extensive use will be made of treated timber whereby even the less durable species may become acceptable. The Government are alive to it and are taking steps in this direction.

India is a big consumer of plywood and our demand is no less than 150 million sq. ft. of which 100 millions are required for tea chests alone. Plywood for tea chests has to be free from both odorous and toxic chemicals and, therefore the selection of a suitable chemical which is toxic to *lyctus* (a wood borer) but not to man presents difficulties Government specifications for commercial plywood demand protection not only of the wood but also of the protein glue lines So far, boric acid is the common preservative employed for the purpose more particularly in plywood for tea chests For uses other than tea chests the protein glue lines can be adequately protected by the addition of 5 to 10 per cent of sodium pentachlorophenate

Extensive use of fibre boards is another way of economizing and conserving our wood resources provided the fibre boards can be suitably protected against termites and fungi, since in a tropical country unprotected boards perish in a comparatively short period of a few months Unlike the plywood protection of building boards presents no difficulty Incorporation of suitable quantities of arsenic and copper salts pentachlorophenol etc in the boards have increased their life from a few months to several years

As the living standard of the under developed countries improves the total quantity of wood and timber needed will increase rather than decrease, even though the *per capita* consumption in more developed countries [illegible] decline Already the use of plywood and wall boards is on the increase Decorative veneer faces over cores of fibrous materials as well as faces of metal sheets paper and various other materials are gaining popularity and promises much for the future of plywood and veneer as well as fibre boards The plywood industry is consequently likely to become more versatile than it now is, and its products are likely to multiply in variety

As a raw material for chemical industries other than pulp and paper manufacturing it appears that wood is opening out new possibilities Take for example, the production of wood sugars by the acid hydrolysis which proved so useful to Germany before and during the war and helped them to meet some of their food and fuel shortages Improvements made since then have reduced the cost of wood sugars by shortening the processing time and increasing the yield so that now it appears possible for wood sugars to compete with other sugars for industrial and animal use in some parts of the world Wood sugars of course are convertible into ethyl alcohol, yeast and many other products The production of power alcohol from wood opens up wide possibilities in those countries which have no mineral oil resources

> Give thanks to mental giants
> Who've done what seemed incredible,
> God made the tree, but science
> At last has made it edible

Since time immemorial wood has been used for making charcoal by destructive distillation and more recently for the collection of by products such as acetone, methyl alcohol and tar products If acetone, etc, were to be manufactured anywhere wood would certainly not be the starting raw material, but as long as charcoal has to be manufactured collection of the by products would remain an attractive proposition Hitherto, the methods of charcoal manufacture have been more or less crude, but improvements in carbonizing equipment and methods that provided better control of temperature are taking place, and it appears quite possible that these may result in sufficient increase in yield of desirable products to make wood distillation more profitable

An example of how wood distillation industry can work profitably is shown by the work of the Department of Industries in Western Australia where, at Wundowie, a wood distillation plant is run to provide charcoal for the production of pig iron from a poor grade iron ore (4% Fe_2O_3) The iron will produce only 10 000 tons pig iron annually and the wood distilled for the production of charcoal yields 120,000 gallons of methamol, and 500 tons of glacial acetic acid as by products The wood tar is at the moment burnt, but it is proposed to convert it into synthetic tanning materials There is no waste product left over in the Wundowie factory, and even the slag is sold away to a concern which specializes in insulating products

Wood contains considerable quantities of oils, resins and other extractable materials that will find greater use in the future than they have in the past Take for example the natural tanning materials Our sources for these have been tree barks, (*e g* babul), pods (*e g* *Caesalpinia* spp) fruits (*e g* myrobalans), etc and we have not devoted enough attention to wood of certain trees as a source of tanning material except perhaps *Acacia catechu*(khair) from which katha and cutch are extracted In Australia the entire tanning material is extracted from the wood of *Eucalyptus redunculus* Wood of this tree has about 15 to 17 per cent of tans but by extraction and concentration a solid extract containing 60 per cent of tans 18 to 20 per cent non tans and 18 to 20 per cent water is marketed Not only is Australia self sufficient in tanning materials but she also exports considerable quantities of these Wattle bark which is indigenous to Australia and contains as much as 35 per cent of tans is not at all cared for because the debarking of the tree for its bark is uneconomic We in this country, still think of wattle bark of South Africa as the tanning material only because our trade and methods are hopelessly conservative

Fatty oils and resins or resin oils for the most part are recovered as by products in processing or hydrolysing, or pulping processes Tall oil, which contains oleic acids and rosin oils, is a by product of paper pulping industry and finds extensive industrial use for making of emulsions and as a plasticizer in certain rubber manufactures Tall oil also contains a certain quantity of wood creosote and this is separated for medicinal use Wood also contains substantial amounts of hemicelluloses that are largely lost in pulping or other chemical processing It appears inevitable that methods will be found for profitable conversion of the hemicelluloses into saleable products, by biological or chemical treatment, and thus build up new industries on a material now worse than useless because of its stream polluting effects

Manufacture of pulp from wood either for the manufacture of paper or pulp suitable for rayon is already a big and a well established industry in Europe and America and for that reason I do not intend giving a survey of the types and quantities of wood that are used in these industries I must rest content by saying that the quantities used are enormous It is estimated that 250 million cubic meters of wood is consumed annually for feeding the paper rayon and other mills in the world But there is one aspect of chemical pulping of wood that I would like to mention Millions of tons of lignin are wasted each year by the world s pulp mills and do much damage by polluting the streams Some progress has been made in the utilization of lignin in various ways but the percentage so used is very small We are slowly working up the chemistry of lignin and learning new facts about it and it would be no surprise if lignin now wasted should find a much greater utilization than at present In certain directions it may replace asphalt and tars

A greater promise for expansion for wood as a raw material lies in its utilization in the production of fibre products In these products the demand is much greater than the supply and with the increase in literacy and standard of living the demand for paper and fibre products is bound to increase greatly Improvements in pulping methods are increasing the yields of pulps thus encouraging the use of raw materials and qualities not formerly acceptable Another advance in the pulping and bleaching technique has recently been announced from the U S A The peroxide manufacturers believe that vast quantities of wood will be saved by using mechanical pulp bleached with hydrogen peroxide Du Pont report that in the production of pulp from wood for paper manufacture the yield of groundwood is approximately double the fiber yield obtained in the chemical pulping processes Such bleaching almost doubles the amount of paper obtained from a cord of wood All such advances tend to make the growing of trees profitable and encourages the use of low quality as well as good quality wood Time is not far when almost any kind of cellulosic material will find some economic use or the other Untold millions of tons of this gift of nature is at present allowed to go waste While the demand is increasing for printing and high quality writing paper it is the coarse fibred raw materials that appear to offer a wide field for investigation It can be stated that future developments would have to be in this direction In the conversion of wood into planks and other constructional material losses of the order of nearly 60 per cent occur, mostly in the form of saw dust Hitherto we have no economic use of this material but recent work in the possibility of producing paper from wood flour by a dry method in which the bonding or felting of the particles is obtained by an electrostatic charge opens up a new field This offers a most economic way of using wood It may be true that we cannot grow two trees where one grew before but we could certainly make one tree do the job of two by making most economical use of every bit that is there Any revolutionary change or development may not be expected but I have attempted to indicate the directions in which research is leading us Many of these are bound to enter the industrial fields sooner or later

The major point in favour of wood as a raw material is its great versatility It can be converted into food, clothing solid or gaseous fuel buildings fibre products and innumerable other industrial products There is consequently no doubt that it is the greatest single raw material placed by nature into the hands of man, and it is at the same time the greatest single raw material which has been abused and misused by man It is therefore our prime duty to grow as much of it as we can and use as much as we like but waste must be avoided A further advantage of wood as a raw material lies in the fact that when stored on the stump under proper management it continues to increase in volume and value for many years Shortages or high prices of oil coal and metal favour the increased use of wood and it is up to us to grow more of it and increasingly enjoy its numerous advantages Greater attention of the chemists engineers and technicians is therefore called for concerted efforts to make the best economic use of wood and develop improved machinery methods of cultivating harvesting and finding cheap methods of converting it into innumerable variety of commercial products Our coal metal and mineral resources are not inexhaustible and certainly not replaceable Consequently wood which can do many of the jobs of coal metals and many minerals and is certainly replaceable should draw greater attention of our scientists and industrialists

Wood is good While much has been achieved, much more remains to be done In the words of Sir Harold Boulton we are by no means at the end of our tether in our studies as to how to render most suitable for every sort of work in fair and honest competition with concrete steel and other materials that material which is the most amenable and acceptable known to mankind for an infinite variety of purposes namely wood

CHEMISTRY OF COAL TAR RESINS

S M MUKHERJI

INDIAN ASSOCIATION FOR THE CULTIVATION OF SCIENCE CALCUTTA

CONSIDERABLE information is available on the very many chemical compounds that have been isolated from coal tar and even during recent years the presence of new compounds has been discovered with regularity However very little is known of the non volatile constituents and very little interest in this part of tar has been displayed Considering that pitch constitutes as much as half the tar and that a considerable part of the pitch is the so called Free Carbon and tar resins these non volatile constituents form a most important material This material may well be of great value and is certainly of great interest and work in this field is expected to be fruitful

In general these resinoids obtained from low temperature tar are pale yellow to light brown amorphous powders precipitated from solution in organic media by the addition of petroleum ether Resins from high temperature tar are usually light brown to dark brown amorphous powder They are found to be of moderately high molecular weight and dissolve in many organic solvents—alcohols acetone chloroform benzen etc When these solutions are evaporated to dryness the resins are left behind as hard transparent films These films can be applied to either wood or metal surfaces The fusing points of the resins range from 100 160 Hence the coal tar resins form a promising basis for lacquers varnishes or polishes They also possess considerable binding power for when mixed with fillers such as coal dust or saw dust and subjected simultaneously to pressure and heat they furnish hard products which can be machined or moulded On testing the resinoids from coal tar gave promising results when used either as lacquers or as vehicles for bronze or aluminium powders By themselves the resinoids darken on exposure but when mixed with aluminium powders little darkening takes place The protective powers of tar resinoids compare favourably with those of cellulose acetate and dammar lacquer vehicles If a bright surface is not essential the resinols and resinenes dissolved in cheap amyl acetates provide a cheaper and more durable vehicle for aluminium paint than the more expensive vehicles now in general use All types of tar resinoids furnish wood stains of even tone without raising the grain of wood Quite apart from the possible better utilization of the materials a study of the constitution and composition of Free Carbon and tar resin should prove of value in the wider theoretical field of carbonaceous materials

In this article it is proposed to summarize the present state of knowledge about the chemical constitution of tar resins as brought to light mainly by the researches of Green and Mukherji[1,2]

All high temperature tars are colloids highly protected lyophobe sols the stability of which depends upon their method of production and subsequent treatment Nellensteyn[3] suggests that they contain three principal groups of compounds *viz*

(1) the medium

(2) the lyophile part the protective bodies and

(3) the lyophobe part the microns and ultra microns

They may be considered after Adam[4] as consisting of four groups of substances *viz*

(1) the suspended or colloidal particles insoluble in such solvents as pyridine known as C_1

(2) a resinous fraction soluble in pyridine but insoluble in benzene which may be present as a protective body either in true solution in the oils or as an ultra colloid known as C_2

(3) the compounds soluble in pyridine and benzene but insoluble in petroleum ether and which are believed to be in a state of true solution in the oils These are described as tar resins —the protective bodies and

(4) the oils otherwise known as the fraction soluble in petroleum ether

Marcusson[5] investigated the formation and the structure of tar resins he found that they contained oxygen in the nucleus and suggested that they originated from oxidation or polymerization of the unsaturated hydrocarobns present in heavy tar oil By absorption of oxygen he inferred lower tar resins are converted into more complex resins By analogy with petroleum asphaltenes and resins he proposed the general name aromatic asphalt for coal tar resins to indicate their character Marcusson s ideas appear to be supported by the work of Morgan and Mitchell[6] who have shown that tar absorbs oxygen with the formation of benzene insoluble resin Adam and Sach[7] however suggest that tar resins are also formed from alkali soluble constituents of tar and that the so called bituminous resin compounds formed during tar distillation are derived not from the saturated or unsaturated hydro carbons but from the alkali soluble fraction The experiences of the author at the Birmingham University are in accordance with the fact that both the above factors play an important role in the formation of tar resins

The work of the author on high temperature tar revealed the existence in tar of neutral basic phenolic (and/or weakly acid and/or lactonic) and acidic products of amorphous and resinous character and for this reason the following generic names were given to them (after Morgan[8])

Neutral resins	Resinenes
Phenolic resins	Resinols
Basic resins	Resinamines
Acidic resins	Resinoic acids

A form of resin, intermediate in acidity between resinols and resinoic acids, was also discovered Its conponents are termed resinilic acids

PREPARATION OF COAL TAR RESIN

There is a possibility in isolating the constituents of coal tar That these are profoundly changed in the process, for certain constituents, although produced in the course of pyrogenic reactions occurring within a range of much higher temperatures, are nevertheless fundamentally decomposed when heated to no more than 150°C In the peparation of the resins described here the tar was not heated above 120°C

Accordingly a sample of vertical retort tar was separated into three groups of constituents —

(1) "Free carbon (C$_1$ +C$_2$), insoluble in benzene or toluene

(2) Tar resins, soluble in benzene but insoluble in petroleum ether

(3) The fraction soluble in petroleum ether

The tar resin was purified by redissolving in benzene or chloroform followed by reprecipitation with excess of petroleum ether when the resinous products were obtained as a grey yellow powder

The purified resin was treated successively with sodium carbonate, sodium hydroxide and hydrochloric acid to separate the acidic, phenolic, basic and neutral compounds The amounts of acidic and basic resins were found to be insignificant, thus the resin from the vertical retort coal tar is composed of about equal amount of resionls and resinenes

RESINS FROM PITCH

Pitch prepared by distilling quantities of the same vertical retort tar, used previously, to 240°C under atmospheric pressure, was resolved in the usual way into "free carbon", resins and "crystalliods" The yield of resins from pitch was about 23% of the pitch or 11% of the tar Attempts to resolve the resin from pitch into the components having different chemical functional groups revealed that it was composed of only neutral resins (resinenes).

To establish definite lines of attack to be applied to tar resins later Green and Mukherji[1,2] thought it expedient first to study the resins from pitch, which were much easier to prepare They also made a comparative study between the resins from coal tar and those from pitch The resins from both the sources are compounds of carbon, hydrogen, nitrogen, sulphur and oxygen

The molecular weights of the resin fractions were determined ebullıometrically using chloroform as the solvent The following tables give the analysis, the proportions of the oxygenic functions and the molecular weights

TABLE I,

ANALYSIS OF RESINENES AND RESINOLS

Fraction	Source	C %	H %	N % (Kjeldahl)	S % (Fschka)	S % (Bomb)	Ash %	O % by diff
Resinenes	Pitch	83 0	5 65	1 8	1 1	1 15	1 35	6 95
Resinenes	Vertical retort tar	82 5	5 25	2 15	1 04	1 3	2 65	6 15
Resinols	Vertical retort tar	72 2	5 85	1 35	0 96	1 05	2 6	16 95

TABLE II

OXYGENIC FUNCTIONS IN RESINOIDS

Substance	Source	Mol wt	No Hydroxyl per mol Alcoholic	No Hydroxyl per mol Phenolic	%O as alcoholic	%O as phenolic	%O as methoxyl
Resinenes	Vertical retort tar	539	0 94	—	0 10		Nil
Resinols		591	2 50	1 3	6 77	3 52	0 62
Resinyl methyl-ether		616	3 46		6 71	—	3 87
Resinenes	Pitch	815	1 70	—	0 11		Nil

Resins from a sample of vertical retort tar gave almost equal amounts of neutral (resinenes) and phenolic (resinol)fractions but the resins from pitch obtained from the same vertical retort tar consist almost entirely of neutral bodies (resinenes) All these fractions contain carbon, hydrogen, nitrogen, sulphur and oxygen Of the oxygen in resinols from tar, about 21% is phenolic, 4% methoxyl, 40% alcoholic and the rest in either higher ether linkages or in rings or both, whereas in the resinenes from pitch about 43% of the oxygen is present as hydroxyl and the remaining 57% should be present as epoxide or other linkages or both The physical properties of all these fractions do not differ markedly except in their molecular weights The average molecular weights of the resinenes and resinols from tar are about 539 and 591 respectively, and that of the resinenes from pitch is about 815 The elimination of the resinol fraction during distillation of tar indicates that this substance is responsible to a considerable extent for the formation of resins of higher molecular weights in pitch

Elementary analysis of the resinenes from pitch gives carbon about 83%, hydrogen 5 6%, nitrogen about 2%, sulphur about 1%, ash about 1 2% and oxygen about 7% The carbon/hydrogen ratio indicates that the resinenes have an aromatic nature This is borne out by bromination when substitution largely preponderates over addition as evidenced by copious evolution of hydrogen bromide The aromatic nature of the resinenes from pitch is also confirmed by the isolation of benzene carboxylic acids from the products of oxidation under conditions which precluded any initial aromatization

Hydrolytic fission of the resinenes from pitch into phenolic and neutral substances shows the presence of alkyl aryl ether linkages The experimental results are in fair agreement with the following equation for the cleavage of ether linkage where R is an aryl and R an alkyl radical

$$\begin{matrix}R-O-R\\H-OH\end{matrix}\qquad R-OH+R-OH$$

It is interesting to note that the molecular weight (508) of the phenolic product of hydrolysis is fairly close to that of the resinols from tar (501) again indicating that resinols in tar may have undergone reaction to give resins of higher molecular weight in pitch

The presence of alkyl aryl ether linkages is corroborated by the results of thermal decomposition and hydrogenation Both of these processes give phenolic as well as neutral bodies which are the expected products from an alkyl aryl ether type of compound

From the results of pyrolysis and hydrogenation it is concluded that nitrogen is bound up in the molecules of resinenes in very stable groupings such as are found in carbozole and dihydroacridine systems But for sulphur the ready and almost complete elimination during thermal decomposition and hydrogenation indicates simple groupings as in hydrosulphides and linear sulphides which are known to be sensitive to thermal treatment However the total absence of nitrogen and sulphur from a fraction obtained in chromatography shows that these elements are not integral parts of the molecules of some of the constituents of resinenes from pitch This is also substantiated by the observations in fractional precipitation

Experiments in fractional precipitation and chromatography show that the resinene fraction from pitch is a mixture of complex chemical compounds Since the several fractions physically differ from each other only in their molecular weights it may be possible that the components of the resinenes are polymeric homologues of each other, i e, they differ from one another largely in the number of structural units.

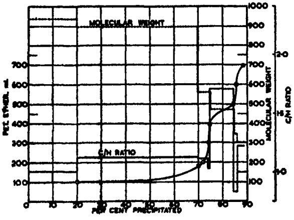


Fig 1 Precipitation curve with molecular weight and CH ratio data.

Dehydrogenation of resinenes with selenium gives anthracene from which two possibilities are considered, firstly that anthracene or partially or completely reduced anthracene systems form part of at least some of the molecules possibly with heavy substituents which are eliminated during selenium dehydrogenation, secondly that the anthracene or reduced anthracene nucleus or nuclei are joined directly or through oxygen atoms these linkings being severed during the drastic treatment with selenium This is supported by the fact that the peak of the spectrogram of the least adsorbed fraction from chromatography corresponds to that of anthracene although the over all nature of the curve is similar to those of some compounds of terpenoid and triterpene groups

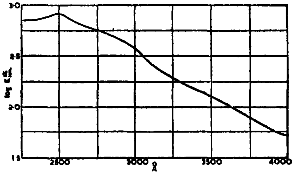
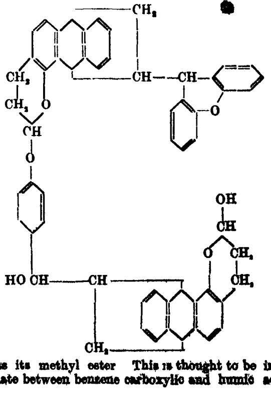


Fig 2 Ultra violet absorption spectrogram of a resinene fraction

Alkaline permanganate oxidation of resinenes from pitch gives besides carbon dioxide oxalic, succinic ophthalic iso phthalic benzene hexacarboxylic and humic acids and also an amorphous acid isolated as its methyl ester This is thought to be intermediate between benzene carboxylic and humic acids,



and from the experimental results the molecular formula, $C_{12}H_6O_2(OH)_2(COOH)_2$, has been assinged to it Owing to similarity between the oxidation products of coal and those from tar resins it seems possible that the fundamental structure of coal may be more or less similar to that of the tar resins

It is tentatively suggested on the basis of the available evidence that the formation of resins in tar and pitch arises from a dione condensation of anthracene with α β-unsaturated aldehydes followed by phenol-aldehyde condensations Thus, according to this suggested mechanism, the resinenes from pitch should have a skeletal formula given above

This type of skeletal formula agrees fairly well with the experimental results for carbon hydrogen ratio, hydroxyl content, the presence of alkyl aryl ether linkages, the formation of anthracene on selenium dehydrogenation and the production of benzene poly carboxylic acids by oxidation However, this agreement cannot be accepted as sufficient evidence for the type of structure suggested and considerably more experimental information will be necessary before a structural type can be assigned Nevertheless, it is hoped that this tentative structural type may prove of some use in the first steps of future work

REFERENCES

[1] Green and Mukherji *J S C I*, *67*, 438, 1948
[2] Green and Mukherji *ibid*, *68*, 16, 1949
[3] Nellensteyn *J I P T*, *14*, 134; 1928, *Science of Petroleum*, Oxford University Press, 1938, p 2760
[4] Adam, *Science of Petroleum*, Oxford University Press, 1938, p 3118
[5] Morgan *J S C I* *47*, 131T, 1928, *48*, 29T, 1939, *51*, 69T; 1932, Fuel, *10*, 183, 1931
[6] Morgan and Mitchel, *Highways and Bridges*, 19th June, 1935
[7] Adam and Sach, *J S C I*, *48*, 337T, 1929
[8] Bone, Horton and Ward, *Proc Roy Soc*, *A127*, 480, 1930.
[9] Marcusson, *Z Angew, Chem*, *52* (*1*), 385, 1919
[10] Mukherji, S M, *Ph D Thesis* 1948, University of Birmingham.

THE MENACE OF WEEDS

M R PANIKKAR

THE INDIAN COUNCIL OF AGRICULTURAL RESEARCH, NEW DELHI

> 'I will go root away
> The noisome weeds, that without profit suck
> The soil's fertility from wholesome flowers '
>
> *Shakespeare* (*Richard II Act 3, Scene iv*)

> "The labours of the agriculturist are a constant struggle; on the one hand, by presenting the most favourable conditions possible, he endeavours to make certain plants grow and produce to their utmost capacity and on the other hand, he has to prevent the growth of certain other plants that are ready to avail themselves of these favourable conditions '
>
> *Wm. Darlington.* 1859

INTRODUCTION

FROM time immemorial the farmer had to contend with unfavourable climatic and edaphic factors, pests and diseases as well as certain unwelcome and undesirable species of plants known as weeds, which interfere with his operations, increase his labour and reduce his outturn. These weeds are defined as plants growing out of place or where not wanted, especially among cultivated plants According to Muenscher (26) whether a plant of a given species is considered a weed depends not only on its characteristics and habits, but also on its relative position with reference to other plants and man. Like other crop plants they vary in general size from the microscopic bacteria and the minute water bloom (*Microcystis flos-aquae*, *Aphanizomenon flos-aquae*, etc.) which pollute water and spoil rice fields to gigantic trees like *Ficus parasitica* which smother full grown palms and other trees, though most are herbaceous in form; some are vines like honeysuckle, dodder, etc, shrubs like *Ulex*, species of *rheus*, etc, and even trees like the trees of heaven (*Ailanthus*), willows, etc, and in their habit of growth, morphology and physiology range all the way from total parasites (like *Orobanche*, *Balanophora*, Dodder etc) to semi-parasites (like *Striga*, *Coranthus*, *Viscum*,,etc.) and then to plants living independent existence They grow almost anywhere on earth, surviving frost or drought, high temperature and humidity, in widely varying soil and climatic conditions, some producing an enormous number of seeds which remain viable for years under the most adverse conditions, multiply rapidly and disperse widely They are ubiquitious, cosmopolitan in tastes, equally at home in rice fields or on railway platforms, on manure heap or on mango branches, on tobacco fields or on tennis courts

However, of the quarter million plants flourishing on earth, few have essentially weedy habits, and seldom does one species have all the undesirable characters attributed to weeds Some (like wild oats, wild rice, mustard, etc) are closely related to valuable crops, a number of species like the grasses kodra (*Paspalum scrobiculatum*) etc though noxious in certain situations are useful in others as food, fodder, shelter, etc, or as drugs and medicine (mints henbane, etc) or as industrial raw materials etc Many weeds (like *Cynodon dactylon*, *Panicum repens*, *Calotropis gigantea*, etc) are desirable soil binders which give good ground cover and prevent erosion

Be that it may be if pests and vermin are a serious menace to crop production, weeds and other noxious vegetation are no less The seriousness of the former has been widely recognised, and adequate measures are taken to control them both in the fields and in the stores (28) But little attention has been paid to the menace of weeds Many take weeds as an unavoidable nuisance or a necessary corollary or compliment to crop husbandry This attitude of apathy and indifference of the farmer and the public adds to the complexities of the weed problem

Economic Losses Loss due to weeds though generally recognised is far greater than usually realised The U.S A Chamber of Commerce estimated (32) the annual loss from weeds as comparable with the more spectacular live stock diseases and insect pests as

	In Million dollars
Diseases of livestock (not excluding death from eating poisonous plants)	250
Insect pests of Plants & Animals	1,125
Plant diseases	1,190
Weeds	3,000

Thus weeds occasion more than double the combined loss by insect pests and diseases in U S A The same organisation listed thirty items of waste in U S A farms, of which weed problem was second only to soil erosion Ryker (34) stated that the loss caused by weeds to Louisiana rice farmers alone is probably well over a million dollars annually About Canada the Associate Committee on Weed Control reported (32) that the crop loss from weeds in yield alone would total well over a million dollars annually It was estimated (22) that before World War I about 16 6 mill on pounds sterling per annum were lost by farmers in Great Britain in growing and getting rid of weeds Woolny (39) estimated the annual loss of crops due to weeds in Bavaria at an average of 30%

An overall picture of the loss incurred directly or indirectly on account of weeds in India, is absent. The few scattered information available about our crop-weed relationship, however, gives some idea about the magnitude of the weed problem in Indian Crop Husbandry The *kans* weed (*Saccharum spontaneum*) has laid waste millions of acres of valuable land in the C.P., U.P, Bhopal, Madhya Bharat and Vindhya Pradesh, causing considerable loss since last so many years. Similarly, wild rice is a serious menace to rice cultivation particularly in the C P, Bihar and Bombay; the loss it causes over 37 lakhs acres of *beasi* paddy in Chattisgarh (C P) alone amounting to more than 22 lakhs of rupees annually (11) In Bengal(6) deep water paddy worth some 11 crores of rupees is supposed to be destroyed annually due to the depredation of water hyacinth (*Eichornia crassipes*) Among the parasitic weeds, broomrape (*Orobanche crenua*) has been found to cause serious damage to tobacco crop, which in Guntur District (Madras) alone has been estimated to be about 25 lakhs of rupees in 1940 and in Bombay nearly 10 lakhs of rupees (19) Similarly other parasitic weeds like *Balanophora* on coffee, dodder on clovers and *Loranthus* and *Viscum* on horticultural crops cause considerable damage in several parts of India, the estimation of which is difficult In Bombay alone ten million lbs of jowar grains are lost due to the infestation of *Striga* causing an annual loss of ten lakhs of rupees

Weeds affect human affairs profoundly They occupy space needed by crops for their fuller growth, deprive them of air, light and heat, steal plant food, absorb and transpire considerable amount of water meant for crop plants make cultivation and harvesting operations difficult and costly harbour injurious pests and diseases of crop plants, some are parasitic in habits and attack crop plants directly or are poisonous and in other ways injure men and livestock, others choke drains, spoil water, injure fish fauna and impede irrigation and navigation They spoil land and reduce the value of crop and livestock products and in manifold ways cause trouble to men and his affairs Not only cultivators and land owners, but railways, highways irrigation, navigation, plumbing and building, parks, playing grounds, cemetery, etc are affected by the insidious presence of weeds So much so, implements and chemicals have been specially manufactured to keep them at bay, Governments all over the world have drafted special laws to outlaw, control and destroy them Consequently an appraisal of the damage done by numerous weeds, is a necessary precursor for any comprehensive study of the weed problem

DAMAGE DONE BY WEEDS

Loss in plant food — Weeds have the same demand upon the land as the crop plants and take up space meant for the latter as well as compete with them for air, light, warmth water and food Probably, the heaviest loss caused by weeds arises from their competition with crops for these fundamental requirements. For the successful growth of crop, an unrestricted amount of light is necessary Weeds, particularly those with large coarse leaves, tend to restrict the supply of light, limiting the photo-synthetic activity of crops by shadowing They also restrict the supply of heat to the soil and crop, as well as prevent the circulation of air Woolny(39) found that the weedy soil was colder to a depth of four inches than a soil kept free from weeds

Weeds absorb from the soil and transpire large quantities of water During the growth of a 60 bushel crop of maize in Cornell University Agricultural Experiment Station 900 tons of water was transpired into the air through the leaves a 25 bushel crop of wheat similarly disposed off 500 tons of water Sunflower plants require almost twice as much water as corn to produce the same amount of dry matter Similarly the water requirements of weeds is also quite high those of rag weed (*Ambrosia artemisifolia*) is about three times that of the millet and of lambs quarters (*Chenopodium album*) fully twice as much as feterita (32)

On investigations of the water requirements of some of the typical weeds which invest arable lands at the Dry Farming Research Station Sholapur(15) during 1941-42 the transpiration coefficient for the flowering stage were 556 for *kunda* (*Ischaemon pilosum*) 813 for *haryali* (*Cynodon dactylon*) 1 108 for *Tephrosia purpurea* and 1 402 for *Tridax procumbens* while it was only 430 for the typical crop *jowar* These coefficients indicate the high water requirements of weeds as compared with those of crops Mijhwan (27) showed that it is possible to save 300—500 tons of water in an acre of soil to six feet depth by keeping it free of weeds under dry farming conditions at Rhotak His later work (10) showed that fallow plots clear of weeds contained 532 tons more water in a six feet column of soil per acre than weeded plots and this quantity of water can produce about 1 600 lbs dry matter of *bajra* Such huge losses of moisture equalling to about five inches of irrigation and capable of raising 30 maunds of crop can be saved if the land is kept free from weeds Weeds are harmful in this way particularly in the hot season more so in arid regions and in areas of precarious or uncertain rainfall and the harmful competition is most felt by cultivated crops on light sandy soils

Weeds feed heavily and their demands for mineral nutrients are great A large crop of weeds need considerable quantity of mineral food which can be obtained only from the soil and from the manures applied for the crop Stutzer and Siedlers work (21) at Koneisberg on the analysis of weeds collected from an oat crop growing in fairly heavy soil with poor humus showed that nitrogen in persicaria (*Polygonum persicaria*) equalled 20% that in sowthistle (*Sonchus oleraceus*) nearly 15% of albuminoids in the dry matter phosphoric acid was chiefly taken up by spurry (*Spergula arvensis*) and persicaria potash by sowthistle and spurry, and lime by persicaria yarrow (*Achillea millefolium*) and cornflower (*Centaurea cyanua*) Robbins *et al* (32) mentioned that charlok (*Brassica campestris*) needs twice as much nitrogen and phosphoric acid and four times as much potash and water as a well developed oat plant, and that the rough pigweed (*Amaranthus retroflexus*) progressively absorbed nitrogen and stored them As to the depletion of soil nitrates by weeds, Call *et al* (7) stated that the upper three feet of soil where the weeds were permitted to grow contained only 81 6 lbs of nitrates while a comparable area with three inches mulch contained 413 8 lbs per acre. According to Crowther (9) in Sudan (Geizara) cutting of [illegible] weeds in cotton at ground level while they were still growing conserved moisture till the rains increased soil nitrates fivefold and led to the increase in yield of cotton crop by 43% over the normal practice

Loss in Crop yield —Weeds cause considerable reduction in the outturn of crops as they compete with the latter for their existence The limited extent to which a cultivated crop can compete with weeds was demonstrated long ago at Rothamstead (33) where a plot of wheat that was allowed to shed its grain and reproduce itself in subsequent years without any kind of cultivation or help against weeds was found in the second year to produce only half the crop less next year and two to three stunted wheat plants in the fourth season after which the wheat crop disappeared entirely an example of smothering by weeds In the Kansas State (36) due to the infestation of field bindweed (*Convolvulus arvensis*) production of rye was reduced by 20% oats by 26% barley by 32% wheat by 42% corn by 67% kaffir by 85% and milo by 89% on an average for the years 1936 40 It is reported (32) that for the farmers in the Canadian Prairies the crop loss from weeds was about 16 20% in 1932 In the U K (30) moderately weeded areas carried from 40 to 50% more crop than those in which weeds were unchecked Long *et al* (22) gave the actual results as between clean and weedy plots of the same crop per acre in barley crop 18 and 6¼ cwts potato 170 and 70 cwts mangold 37½ and 16½ tons and in oats 67 and 47 and also 76 5 and 24 8 bushels In Norway (17) the percentage loss in money value on a weedy plot compared with clean plot in crops of hay was 47% barley 46% and potato 46% In Sudan (Geuzara) (9) yield of cotton was reduced by 30% due to weeds

In India at a conservative estimate the reduction in yield of cotton caused by *kans* is at least a third of the crop (18) of rice by wild rices 5 to 30% in C P and Bombay (35) and 50 to 60% in the Kangra Dist of Punjab and by *striga* 80 to 90% in the *modan* lands of South Malabar (37) in the general crop yield by about 50% due to nut grass (*Cyperus rotundus*) (28) while the reduction in the yield of crops in general by weeds as a whole may be upto 30%(23)

Hinder agricultural operations —A multitude of weeds (*Ischaemon pilosum Cyperus rotundus Clerodendron laegifolia* etc) if present in cultivated fields, hinder ploughing cultivation earthing etc rendering them difficult and costly Consequently for the control and elimination of these weeds special and costly equipments including tillage implements manures, sprayers burners etc are needed It was estimated (32) that the average cost of tillage in cultivated land in U S A as 16% of the value of the crop approximately one half of the cultivation being necessary due to the presence of weeds Similarly the average cost of tillage to keep down weeds in India is reckoned as $\frac{1}{13}$ or more of the value of the crop(14)

Certain climbing and binding weeds like the bindweeds (*Convolvulus arvensis C sepium Polygonum convolvulus* etc) twine themselves round crop plants and drag them down wild vetches cleavers (*Galium aparine*) etc break down corn crops by sheer weight Thorny weeds like *pohli* (*Carthamus oxycantha*), *Kandiyari* (*Solanum xanthocarpum*) etc obstruct reaping operations, the bindweeds wild oats (*Avena fatua*) etc impede harvesting operations and mix with the produce

Presence of creeping thistle (*Cirsium arvense*) in quantities annoy reapers, cause extra wear and tear to the implements as well as reduction in the value of straw The bindweeds, coltafoot (*Tussilagoo farfara*) etc if mixed up with the harvested stock will retain moisture, retard drying and curing of grain, heat and invite moulds etc Fragments of weeds like wild radish (*Raphanus rhaphanistrum*) etc cause spoilage of threshed grain during storage and transit

Reduce the Quality of Crop Products—Weeds like the mustards (*Brassica alba*, *B nigra*, *B campestris*, etc), ragweeds (*Ambrosia sp*), corncockle (*Lynchnis githago*) etc contaminate crop products by their presence and depress the value Clover samples containing dodder (*Cuscuta chinensis*) or other weed seeds fetch much depreciated price Wheat for million purposes get considerably reduced in price if it contains bulbils of wild onion (*Allium canadense*), wild garlic (*A vinale*), annual yellow sweetclover (*Melilotus indica*) or seeds of black bindweed (*Polygonum convolvulus*), wild or cultivated tares, etc as they contaminate the flour by imparting undesirable and objectionable flavour Presence of seeds of darnal (*Lolium temulentum*), cockle bur etc render crops dangerous for consumption due to their toxicity

In trade, weed seeds and other foreign matter form "dockage" causing reduction in the normal price of the commodity in which they are discovered in appreciable quantities It is particularly high in the cereals, in which its average is about 1% in U S A (32) Want of proper cleaning and preparation has often times been pointed out as the prime cause for the low price Indian crop products fetch n international markets, and no wonder, since their dockage content is many times more than in U S A or elsewhere Some idea of the dockage and that too injurious to public health present in some of our crop products can be had from the Proceedings of the Fifth Ordinary Meeting of the Indian Central Oilseeds Committee held on Octobr 29 1949, where it is mentioned that the Bengal Oil Mills Association complained that in the mustard seed from U P the percentage of argemone (*Argemone mexicana*) has increased from 3 to 4% in recent months Similar complaints about kesari (*Lathyrus sativus*) is not infrequent The high percentage of dockage in our food grains has compelled the Agricultural Ministry to set up a committee to enquire about the quality of our food grains.

Apart from these, if the crop products are not cleaned free of weeds and their propagative parts, farms are faced with the possibility of introducing weeds. in the r newly sown crops too admixed with h's seeds Advanced agricultural countries have seed cleaning machineries, practices and laws regulating the sale of crop seeds and controlling the sale of those containing undesirable weed seeds India has still to fall in line with such fortunate countries

Serve as Collateral Hosts to Crop Pests—In addition to serving as hiding places for insects weeds oftentimes serve as intermediate or collateral hosts for numerous insects and other pests. Several species of weeds are known to be hosts of one or more virus diseases of plants, aster yellow is spread by the sixspotted leafhopper common on many wild hosts, particularly on the common plantain (*Plantago major* and *P lanceolata*) The bacteria of bean blight lives on wild legumes and that causing black leg of cabbage upon wild mustard (*Brassica arvensis*) Black rust of wheat is found on *Bromus patulus and Brachypodium sylvatum* which grow in Kashmir and in Simla hills *Digitaria marginata*, *Dinebra retroflexa*, *Leersia hexandra* and *Panicum repens* are found to be the hosts of the fungus causing blast disease (*Piricularia oryzae*) of rice in Madras (3) The pink boll worm of cotton is found on the wild relatives of the plant while the sweet potato weevil is harboured by wildmorning glory (*Convolvulus arvensis*), and *Datura* Spp (*Datura stramonium* etc) are hosts to red spider, cotton aphid, potato flea beetle and many other pestiferous insects The chief food plants of the fruit moths (*Ophideres materna*, *O fullonica* and *Annus contrata*) which are responsible for considerable damage to fruit trees in the Krishna District (Madras) are mostly weeds (1) Grasshoppers, nematodes, and numerous other destructive pests of crops find asylum on weeds Consequently, if the weeds could be eradicated some of the worst pests of our crops are also simultaneously liquidated

Parasitise Crop Plants—It is seldom realised that plants which normally flower and set seed can parasitise on other plants to their detriment and damage None the less, damage done by flowering plant parasites to some of the crop plants is often very severe These classes of weeds can be broadly divided into two, *viz*, those which are partly parasitic and partly independent (hemi parasites), possessing green pigment to manufacture food if necessary (like *Striga*, *Loranthus* etc), and those that are entirely parasitic (holoparasites) which lacking in chlorophyll have perforce to depend upon other plant hosts, for their food and nourishment (like dodder broomrape, etc)

Striga attacks the members of the grass family (18), the principal crops affected in India being sugar cane, millets and rice The parasite depletes the hosts of their food making them weak and unproductive and more often than not destroying them It attacks the hosts at any stage, at the early stages of the host it causes considerably more damage than in later stages. It is slow spreading and adapts to varying conditions of soil and climate It is widely distributed from the Punjab in the North to Travancore and Malabar in the South. Sugarcane is severely attacked by *Striga* in the Central Provinces and Hyderabad, while in some parts of Madras, Mysore, Hyderabad, Bombay and the Central Provinces, it causes considerable damage to millets. Elsewhere in South Malabar, *striga* has become such a serious pest on rice crop in *modan*(dry hill slope)lands that ryots are forced to abandon cultivation in such areas (37) The parasite produce large number of minute seeds which remain viable in the soil for even half a century and easily spread far and wide by wind and other agencies Similarly, Arabica coffee (*Coffea arabica*) plant is subject to the attack of a species of

Balanophora It is a leafless weed occurring in the form of tuberous outgrowths on the lateral roots of the coffee plant, which when mature appear above ground to flower and set seed The seed gives rise to fresh parasites The attack of this parasite generally impairs the vitality of the coffee bush and reduces its yield In the broomrapes, though there are in all about 90 temperate and sub tropical species (19) fortunately only few occur in India, and fewer still parasitise economical crops Of the two species noted in India *Orobanche indica* causes damage to the members of the cruciferous family (like mustard, rape, cabbage, etc) while *O crenua* attack mostly solanceous plants (like tobacco, brinjal, tomato, etc) Being a total parasite it drains the hosts of their nutrients to utilise them for their own growth The effect of the attack of this parasitic weed, as in *striga* depend much upon the age of the hosts, if the attack is early in the development of the host plant, the latter succumbs, if later the injury may be limited to the stunting of growth, while in the case of tobacco crop the quality of leaf may also be considerably reduced in addition to yield This noxious weed is spread and perpetuated mainly through innumerable minute seeds spread by wind, water and other agencies The seeds remain viable in the soil upto ten years The approximate estimate of the damage and loss due to this weed on tobacco is to the extent of 5 to 10% in Bengal, 15 to 20% in Bombay, 20 to 30% in the Central Provinces and 30 to 70% in Madras, the severest attack being in the lankas of the Godavary Deltas where upto 75% damage was reported

The stem parasites, like *Loranthus* and *Viscum* cause serious damage to horticultural crops The former is a serious pest to mango trees particularly, in some cases every branch of the tree may be affected when big trees and whole plantations may be destroyed in the course of time (20) As a serious pest of clover dodder (*Cuscuta chinensis*) is spread all over the country wherever this fodder crop is grown The seedlings of this total stem parasite attach itself to the stem of lucerne or of other members of the morning glory family It lives entirely on the host penetrating into the latter s tissues by numerous suckers, to develop eventually into a tangled mass of yellow filaments and destroy it This noxious weed affect other economic plants (like *Euphorbia nerifolia*, *Bidelia retusa*, *Terminalia tomentosa*, *Acacia arabica*, *Eugenia jambolana*, *Solanum melongena*, *Andropogon annulatus*, etc) too

Poison Men and Livestock—Chopra *et al* (8) mentioned 700 poisonous plants in India, a large number of which are weeds, some weeds are also abortificient or cause dermatitis and other injuries (4,5) to men and livestock. According to Kehar (16) cyanogenetic glucoside is widely distributed in many plants and HCN is found in 148 species of plants belonging to 41 families Though some of these plants have characteristically unpleasant odours, acids, bitter tastes, spines, etc the poisoning of animals by such plants is a common occurrence in India, inspite of the widespread belief that they are protected by some instinct from eating dangerous plants. The injury due to 100 species of poisonous plants amount to 8% of Colorado's livestock (12) and the annual loss in U S A due to cattle poisoning is estimated to be over 200 million dollars Similar losses are noted also in the U K , South Africa, Australia and Germany In India where pasture policy is absent, fodder is scarce, natural pastures over grazed, the limited public grazing grounds infested with numerous weeds and with the largest cattle population of the world to feed the loss due to plant poisoning of livestock will be nothing short of phenomenal

Reduce quantity and quality of livestock products Other weeds, though not so seriously harmful, as those mentioned above are yet capable of reducing the output of livestock products both in quantity and quality They taint milk butter or meat or spoil wood and hide Ragweed, marsh elder smart weed, mustards etc impart flavour and odour to the milk of cows that browse on them and millions of dollars are thus lost in U S.A Many common weeds (like wild oat, wild barley, puncture vine, etc) possesses sharp awns, barbs, etc which cause serious mechanical injury to livestock. Some like piano grass (*Themeda arguens*) may cause sore mouth, eye wounds etc while others like bur weeds may become entangled in wool or hair to lower its quality or become embedded in the skin and cause fly strike with eventual damage to hide and skin, others (like *Pupalia alopurpurea*, *Triumella rotundifolia*, *Lolium temulentum* etc) may cause loss of condition, affectation of embryo, deformation of organs other temporary or permanent injuries etc Certain types of needle grasses may become embedded in the flesh of the livestock and materially lower the quality of the carcass too In India, the loss incurred annually through poisonous plants is drop in milk yield, loss of meat and wool abortion and sterility, temporary or permanent injuries to the various organs of the body and may exceed 20% of the value of the total livestock of India or nearly 400 crores of rupees (38)

Choke drains and Irrigation Spoil water —Growth of roots and other underground parts of weeds are sometimes responsible for the stoppage of drains and cause considerable expense The water hyacinth and other noxious water weeds choke irrigation canals and block waterways, particularly in Bengal and Kerala, causing considerable inconvenience and expense The Bureau of Reclamation which has only less than 1/7 of the irrigated land in U S A under it spend yearly more than hundred thousand dollars in dragging weeds of irrigation canals and ditches, while the office of the Chief Engineer's spends upwards of ½ million dollars yearly to clear small temporary channels (24)

Water weeds like duck weed (*Lemna paucicostata*), *Pistia*, etc pollute drinking water by their very presence Water hyacinth has robbed thousands of villages in Bengal of clean drinking as well as bathing water It may be calculated that on an average four acres of water area of each village in Bengal are so infested (6) Thick surface of coarse water weeds screen light and create unhealthy conditions for water fauna causing sometimes heavy mortality in fishes Bengal sustains according to Basak (6) an annual loss of some hundred million lbs of ash estimated to cost about ten, crores of rupees due to water hyacinth Aquatic grasses (like *Cyperus*, *Marsilea diandra*, *Panicum cruss-galli*,etc) are troublesome weeds of the swamp rices in South India, elsewhere other weeds (like *Typha angustifolia*, *Ottelia alismoides*, etc) too spoil rice fields

Spoil land and reduce their value —Many weeds infiltrate into good arable lands, get tenaciously established, render them unfit for use and reduce the land value Further poison oak (*Rhus diversiloba*), poison ivy (*R toxicodendron*) and poison sumac (*R vernix*) etc by their presence reduce the value of land for resort purposes and summer sites McCall(24) reported that millions of acres of good agricultural lands in U S A are virtually out of production due to noxious weeds

Similarly in India not less than ten million acres of land are infested with *kans* mainly in the regions of northern C P , Madhaya Bharat, Vindhya Pradesh and in certain parts of the U P (2) *Kans* (*Saccharum spontaneum*) grows both in the rich and poor soils, but infests particularly heavy rich soils which it exhausts of nitrogen sucking also water from the deeper layers by its penetrating and deep root system , so much so, due to the progressive depletion of soil nutrients and water, the weed die itself if the land is left fallow for prolonged period But the death of this tenacious and pernicious weed is followed by equally obnoxious shrubs like *babool*, *dhak*, *karonda*, etc to reclaim the land for eventual reversion to shrubby thickets This weed has laid waste millions of acres of valuable land causing since last so many centuries billions of rupees annual loss to the nation In the U P alone more than five lakhs of acres are so badly infested with *kans* that unless immediate steps are taken to save the good cultivated land there is danger of the whole area going out of cultivation in the near future

The nut grass (*Cyperus rotundus*) is a particularly pernicious weed noted on all types of soils all over the country With unusual adaptations for tiding over long dry spells of the year, *harıali*(*Cynodon dactylon*) infests all types of soils equally severely In a field which may show only four to five shoots of the weed per square foot, over 75% or more of it are unfit for economic cropping Due to its perennial life and resistance to drought, its presence in cultivated field is an unmistakable menace to the economic welfare of the ryots.

Similarly, *Baru* (*Sorghum halepense*), prickly pear (*Opuntia* sp), *Gokhru* (*Xanthium strumarium*), *Pluchea lanceolata* etc are also noxious weeds invading crop lands, laying them waste and making them unfit for cropping

Encroach on non-arable lands —Another aspect of the loss due to weeds is in their encroachment on playgrounds, roadsides, railway lines, etc for which some of the weeds (like *Alternanthera echinata*, *Tribulus terrestris* etc) are particularly notorious The U.S A. (32) spends about 2¼ million dollars annually for clearing railway rights of way of weeds at ten dollars per mile Our expenses on account of weeds in these unwelcome situations must be equally large if not more, though want of separate statistics on this item of waste is not surprising in the present elementary state of our knowledge on the whole problem

Weed Prevention and Control —There are two methods of approach to the weed problem , either to keep weeds under such control that their baneful effects are restricted or limited, or to work out their outright eradication It may be possible and practical to eradicate certain weeds (lik *Striga*, broom rape, etc) infestation of which are limited in extent , on the other hand there are many weeds (like nut grass, *hariali*, etc) which are so widespread or so dispersed that eradication though desirable would be impractical if not uneconomical In general , the most common species of annual weeds are held under control without actual eradication which would have been costly to be thorough However, whatever may be the comparative merits of the two, prevention of infection is better than control or eradication

Weed infection, control and eradication are events of sequence , weed infection make us liable to notice it and take to control measures, which if found insufficient to check the pest, compel us to look to and plan eradicatory measures Weed infection is mainly through seeds implements manures, irrigation soil, etc and pure seed, clean cultivation, irrigation, manuring and well planned rotation of crops to give room for timely and proper tillage practices are the fundamental factors in preventive measures

On the other hand, the actual control of weeds usually require the use of one or more methods cultural, biological or chemical, any one of which may be used along or in combination or complement to one another Cultural methods include tillage, rotation of crops, growing of the so-called smother crops, or any system of farming which may aid in weed control But in the last decade careful and extensive studies of plant chemistry, physiology and ecology have made it possible to revolutionise the whole system of chemical weed control involving contact sprays to combat general weed growth, selective sprays and dusts against broad leaved weeds in cereals and other crops, translocated sprays against deep rooted perennials, soil sterilising chemicals against both deep and shallow rooted weeds, and finally the hormone weed killers for selectively killing dicotyledonous or monocotyledonous weeds in a mixed population The last has revolutionised the very problem of the herbicidal control of weed, some of them (like 2, 4 D, Chlorophenoxyacetic acid, etc) are found to have selective action against dicotyledonous weeds only, while others (like N, N-D Carboethoxyanilin, Isopropyl-phenylcarbamate, etc) seem to have the opposite effect, being selectively lethal to monocotyledonous plants (29) though remaining harmless to dicotyledonous This seems to open up a vast vista of future possibilities in discriminate control of weeds by harmones alone

This does not, however, indicate that the weed problem as it exists in India could be solved by chemical eradication, much less by these new weed killers only, as the trial on these should be conducted under conditions experienced locally, since weeds vary greatly in their virulence and aggression in different soil climatic conditions, in relation to different crops, and in many cases control revolving round specialised programmes planned for particular species, and the time honoured practice of clean farming methods can be superseded by these new chemical means Each has its place But at the same time weed control is no longer a simple matter of well prepared seed bed and maintenance of good crop rotation With the ever increasing facilities for travel and transport space has been literally annihilated, and the whole world has shrunk in size opening easy and rapid national and international exchange of goods with the eventual dissemination of global weed flora far and wide

Timely and adequate tillage weed free seed, good rotation and crop sequence, and quarantine against weed contaminated outside seed and feed should be the chief reliance against weed infection, biological and chemical methods are only supplementary, and the ultimate criterion of effective weed control is the smoothness with which it fits into the usual farm routine, as whatever we may do the eventual success depend upon making weed control an integral part of the day to day farm operations One thing is sure everything that contributes to better farming constitutes in some degree to the control of weeds

SUMMARY AND CONCLUSION

The war between man and weeds which encroach on his cultivation had begun since the primitive man eschewed his nomadic life in favour of sedentary cultivation It has been going on everywhere since the menace of weeds is a national as well as an international problem In the context of the complexities of the world food scarcity, the part played by weeds in the same, is particularly significant It is worth while to recall the remark of Merck (25) that weed destruction through the use of 2, 4-d has led to increases ranging upto 30% in the world needed grains

In this note an attempt is made to indicate the extent of the 'Menace of Weeds' to the life and living of the human population all over the world, with particular reference to India Data on various aspects of the problem extending to almost all aspects of human activities, is unfortunately meagre The available information, mostly piecemeal, however, is sufficiently impressive to make us sit up and take notice For example, if all the *kans* infested land in India could be reclaimed within the next few years, it alone will have added nearly three million tons of food and wiped out our food deficit

Considering the enormous wastage of the actual and potential food resources of the nation caused directly and indirectly by weeds, no measure is too much to control and eradicate them Preventive, control and eradicatory measures and modern developments in the same are briefly mentioned And there is sufficient reason to believe that we are on the verge of great advances in the use of selective weed killers and in the methods of application However, it is essential to have a coordinated Weed Research Programme covering the whole Indian Dominion to study the problem of weed incidence and its economics in relation to crops soil, climate, weed species and existing agronomical practices etc with the prime object of shaping workable and practical methods of weed control useful to the ordinary farmers The Indian Council of Agricultural Research has already taken initiative in the matter

REFERENCES

(1) Anonymous Review of Agricultural Operations in India, 1923 24, p 87 Government of India, 1924
(2) ————Reclamation of *Kans* lands Agriculture ministry Pamphlet No 2 Government of India, 1949
(3) Progress Report of the Scheme of Research for the investigation of Blast and Foot Rot diseases of Rice in Madras Presidency 1948 49 ICAR, Govt of India, 1949
(4) Badhwar, R L *et al Ind J Agr Sc 15* 155 71, 1945
(5) —— — *16*, 342 55, 1946
(6) Basak, Meghnath Water Hyacinth Compost Govt. of West Bengal 1948
(7) Call, L E *et al Am Jour of Agron 10* 35 44, 1918.
✓(8) Chopra R N *et al Ind J Agr Sc 10* 1 44, 1940
(9) Crowther Frank. *Emp J Expt Agr 11*, 1 14 1946
✓(10) Dalip Singh & Nijhwan. *Ind Fmg 5*, 168 69 1244
(11) Davae, B B *Ind J Agr Sc 13*, 46 53, 1943
(12) Durrell, L W *et al* Colo Agr Expt Stn Bul 455, 1939
(13) Howard, A *Agri J Ind 22*, 1927
(14) Iyengar, Gopalaswamy Complete Gardening in India, Huxley Press, Madras 1935
(15) Kanitkar, N W Dry Farming in India, ICAR Sc Monograph No 15, Govt of India, 1944
(16) Kehar, N D *Ind Fmg 4*, 130 31, 1943
(17) Korsomo, E *Tidskr Notske Lambr 10*, 247 80 and 295, 1903
(18) Kumar, L S S *Ind Fmg 1* 593 95, 1940
(19) ———————— *3* 638 40 1942
✓(20) ———————— *5* 460, 1944
(21) Long, H C Min of Agr & Fisher Bulletin No 108 H M Stationery, 1939
(22) ——& Brenchley, E W Suppression of Weeds by Fertilisers & Chemicals Crosby Lockwood & Co London 1946.
(23) Luthra, Jai Chand Punjab weeds & their control. Govt. press, Lahore, 1938
(24) McCall, M A *J Am So Agron 37*, 378 86, 1945
(25) Merck S W *Chem Eng News 25*, 3496, 1947
(26) Muenscher, W W Weeds, p 3 Macmillan, 1947
(27) Nijhwan, S D *Ind Fmg 5* 58 60, 1944
(28) Panikkar, M R. SCIENCE & CULTURE, *13*, 59 66, 1947
(29) Pearse, H L Growth promoting substances and their practical importance in Horticulture, CAB Tech Comms No 20 pp 71 72, 1948
(30) Percival, J Agricultural Botany, 4th Edn, 1910
(31) Pillay A P *Ind. Fmg, 5*, 67 68, 1944
(32) Robbins, W W *et al.* Weed Control, McGraw Hill, 1942
(33) Russell, E J The Book of Rothamstead Expts 2nd Edition, 1917
(34) Ryker, T C *J Am Soc Agron 39*, 395-402, 1947
(35) Salimath, S S *et al Agr Liv Stk Ind. 7*, 479-92, 1937
(36) Timmons, F L. Kans Agr Expt Stn Bul, 296, 1941
(37) Uttaman, P *Madras Agr Jl 36*, 303 307, 1949
(38) Venketachalam V *Ind Fmg 4*, 571 75, 1943
(39) Woolny, Fr Maier Boode Die Bekampfung der Acker Unkrauter, 1908

ZIRCON AND SILLIMANITE IN TRAVANCORE

P VISWANATHAN

THE occurrence of titanium minerals in beach sands of Travancore has been dealt with in a previous note* The purpose of this note is to give an account of zircon and sillimanite which also occur in the beach deposits of Travancore

Zircon and sillimanite occur in the better known beach deposits of Travancore in workable quantities Concentrates of zircon were first produced and exported from Manavalakurichi in the early twenties of this century Sillimanite was discovered in the Quilon beds while studying floated concentrates of zircon First shipments of sillimanite were made by Travancore Minerals Company in 1937

The non magnetic tails from the primary magnetic separation of ilmenite contain all the zircon and sillimanite mixed with unseparated ilmenite When this residual ilmenite is removed by high intensity magnetic separation, the zircon and the sillimanite pass into the non magnetic fraction along with the major portion of rutile Zircon was produced by the time honoured methods of gravity concentration, for the elimination of silica and sillimanite, combined with high intensity electro magnetic separation for the elimination of rutile These methods were naturally laborious, recoveries poor and the ultimate purity of the final products left much to be desired Forth flotation was successfully employed by Travancore Minerals Company to concentrate zircon and sillimanite and following the installation of flotation plants both at Chavara and Manavalakurichi in 1936, zircon and sillimanite of nearly 99 per cent purity were produced Later on studies in the electrostatic concentration of rutile yielded other methods of concentrating zircon and sillimanite, but this interesting exploratory work was unfortunately halted by the suspension in the production of by product minerals, zircon, sillimanite and rutile

ZIRCON

This is a silicate of zirconium well known in the refractory industry The technology and the industrial application of zirconium and its compounds have been studied by only a few specialists in the world, prominent of whom are the Deutshe Gold and Silber Scheideanstalt of Germany and the Foote Mineral Company, Philadelphia, U S A Progress in the study of the chemistry and metallurgy of zirconium is reflected in the increasing tonnage of zirconium minerals consumed in the industry and the variety of the uses to which zirconium minerals are put A distribution of the uses of zirconium minerals in 1946 were** refractories 28%, vitreous enamels 25%, electrical and chemical porcelains 19%, metals and alloys 16%, pottery glazes 10%, and miscellaneous 2%

The production of titanium and zirconium had been studied in Germany as far back as 1934 "The demand, especially for zirconium, increased during the war, attaining a total of about 48 tons during the period October 1939 to end of 1944, and reaching a peak of more than 15 tons in 1943" This is disclosed in the findings of a delegation of Canadian Scientists* sent to Germany soon after the War by the Department of Reconstruction in 1945, who visited the sole producer of titanium and zirconium metals in pure form, the Deutshe Gold and Silber Scheideanstalt (commonly called *Degussa*) In their abstract of the uses of zirconium they state —"Pure zirconium was used in flash bulbs, in vacuum tubes and in time fuses of bombs where it has a definite advantage because it gives no gas in burning Under the form of alloy, it was used with other rare metals for making substitutes for platinum, it was also used as a scavenging agent in high grade steels'

The fused oxide has a melting point of 3,000° C and a specific gravity of 5 89 The natural oxide of zirconium, Baddeleyite which occurs in large quantities in Brazil and traces of which are now known to occur in Travancore sands, could be freed of its impurities by continuous leaching with acid and prolonged heating at very high temperatures when the chief impurities of iron oxide, silica lime etc are volatilised leaving the zirconia unchanged Platinum can be melted in crucibles made of a mixture of zirconia and magnesia For small scale laboratory use where extreme resistance to high temperature and sudden temperature changes are required, zirconia ware have been found to be far superior to any other refractory A recent application describes the use of zirconia as a refractory coating on molybdenum sheets, thin specially designed coatings of zirconia on the metal increased its resistance to thermal shocks and to high temperatures at which the metal would soften and thin out without the coating

The impact resistance of steel is substantially improved by small additions of zirconium The pure metal is used in vacuum tubes, flash bulbs and pyrotechnics Addition of 0 5 to 1% zirconium to manganese base alloys profoundly refines the grain permitting high speed rolling and extrusion A lamp using zirconium di oxide as a pin point cathode emitting a brilliant white light has been developed recently

Shipments of zircon to consumers reached a new record of 20,555 short tons in 1946 as against 15,988 tons in the previous year, according to the Minerals Year Book, 1946 Australia figured as the biggest producer, with Brazil as the next important source Domestic production in the U S A too increased, but 'no zircon was produced in India (Travancore) which had averaged 1,600 tons annually during the decade ending 1942 '

---

* SCIENCE AND CULTURE, *11*, 45, 1949

** Minerals Year Book, 1949

* Roger Potvin and G S Farnham, Canadian Institute of Mining and Metallurgy, *Transactions, Vol. XLIX*, 1946, pp 516-524.

SILLIMANITE

Sillimanite, like zircon is also concentrated from the residues obtained in the production of ilmenite It concentrates in the lighter fractions from the gravity tables concentrating zircon Sillimanite too is best concentrated by froth flotation Along with the stoppage of the production of other by products the production of sillimanite also was stopped at a time when the industrial uses of the mineral were expanding

Sillimanite is one of the three natural silicates of aluminium, the other two being kyanite (also spelt cyanite) and andalusite, all of the chemical composition Al_2O_3—SiO_2 The ceramists of the States Bureau of Standards, U S A were given the problem of developing a better spark plug core in 1917 Sillimanite was chosen for trials but as the natural mineral was scarce they decided to experiment with artificial sillimanite which they produced by intimately grinding clay and alumina in appropriate proportions and firing the same to 1550°C The resulting body was found to be very satisfactory capable of greatly improved heat shock resistance and of having a mechanical strength of 2 to 4 times that of normal porcelain. Great demand arose therefore for the natural mineral and most of it came from India under the trade name "P B Sillimanite' Travancore sillimanite is purer than the P B material but is in sand form

Sillimanite melts at 1810°C and finds extensive use in the manufacture of electrical insulators, pyrometer and furnace parts and special fire bricks

The production of zircon sillimanite and rutile has now come to a stand still in Travancore Brazil was the other competing producer of these minerals before and Australia has made great progress in the production of zircon and rutile during the past few years *

---

* Since this note was completed Travancore Minerals Company, the oldest concern engaged in the production and marketing of the beach minerals of Travancore has been taken over by the Government of the United State of Travancore and Cochin and is running as a Government concern.

THE INTERNATIONAL UNION FOR THE PROTECTION OF NATURE

LT-COL R W BURTON

THE (I U P N) was established at Fontainebleau on the 5th October 1948 Thirtythree countries in all were represented at the Conference

A clear definition of the meaning of 'Nature Protection" was given —

> "The term ' Protection of Nature may be defined as the preservation of the entire world biotic community or man s natural environment which includes the earth s renewable natural resources of which it is composed, and on which rests the foundation of human civilization

It was also declared that

> — — -ever more effective means for exploiting these resources (are required) and moreover soils water wild life and wilderness areas are of vital importance for economic social, educational and cultural reasons

Also that

> ' Protection of Nature is a matter of vital concern to all nations, and the furthering of it is the primary concern of no single effective international agency '

The objects of the Union were declared to be

1 The Union shall encourage and facilitate co-operation between governments and national and international organizations concerned with, and persons interested in the Protection of Nature"

2 The Union shall promote and recommend national and international action in respect to

(a) The preservation in all parts of the world of wild life and the natural environment soils ,water forests, including the protection and preservation of areas, objects and fauna and flora having scientific, historic, or aesthetic significance by appropriate legislation such as the establishment of national parks, nature reserves and monuments and wild life refugees, with special regard to the preservation of species threatened with extinction ,

(b) The spread of public knowledge about "Protection of Nature";

(c) The promotion of an extensive programme of education in the field of the Protection of Nature ,

(d) The preparation of international draft agreements and a world wide convention for the Protection of Nature";

(e) Scientific research relating to the Protection of Nature

3 The Union shall collect, analyse, interpret and disseminate information about the Protection of Nature It shall distribute to governments and national and international organizations documents legislative texts scientific studies and other information concerning the Protection of Nature

Under the initiative and auspices of UNESCO, an international and technical conference on the Protection of Nature was assembled at Lake Success on August 22 27, 1949 and passed a series of 21 resolutions of world wide importance

All the above is set out for the information of those who may not be completely aware of the origin and purposes of this new born Union whose activities are of vital moment to all peoples of the world , and to have clearly in mind the purposes of the Union for a consideration of their bearing on conditions prevailing in India

The First Resolution

Within the seven paragraphs of the first Resolution is clearly and concisely outlined why and how it is necessary to increase knowledge of human ecology, by whom this should be done, the methods necessary and, finally

> "7 The results of these studies should be published and made available to specialists. Also popular versions of the scientific results should be mabe available in several languages to the general public

The underlined words contain the real kernel of the matter Grandiose scientific resolutions can be of no final practical value unless the facts and results of scientific investigations and researches are visually placed before the literates of the people (which includes the various grades of all the administrative departments concerned) through suitable popular literature and demonstrated on the land and in the forests to those sections of the people who are vitally affected in their living conditions by the scientific conclusions in various fields of research

Practical methods for giving effect to this will be for consideration by the Central and Provincial governments, perhaps the solution may lie with the radio, which has been likened to the spreading branches and tendrils of a banyan tree penetrating to all parts of the country, supplemented by cinema and propaganda vans visiting all village weekly markets and also contacting rural population throughout the land

Lately, prominent people have said

"Ultimately it is on the application of science that all progress depends" and,

"There is lack of adequate provision to put the results of research into actual practice '

Soil and erosion, water and increase of productive acres, overgrazing, improvement of fodder supplies and of cattle breeds, afforestation outside forest areas to remedy past neglect and present misuse, urban and rural planting of trees including provision and maintenance of tree nurseries, proper planting methods and methodical post planting maintenance are some of the most important directions in which effort is urgently called for

Then there is the need for village communities to provide for themselves by establishment of village coppices, and other plantings of selected varieties, much needed fuel and wood for numerous agricultural requirements—sheds, carts, ploughs, hedges etc

Practical fish conservation is necessary It is not only through pond and tank culture, but through protection of the natural supply which is in all the waters of this country in great abundance, if guarded against wasteful and illegal destructive methods, that the people can obtain the much needed proteins in their diet Also, for many years and right up to the present time, weirs and dams across rivers in many parts of India have, almost without exception, been unprovided with efficient ladders for needs of migratory species of fish Consequently some of the great rivers and their tributaries have been largely denuded of certain species of great economical value

There is great necessity for protection and conservation of wild life, fauna and flora according to the methodical order called "balance in nature" In this the aid of scientists is called for Uninstructed clamour on the part of the cultivating classes entailing the destruction of edible species of animals and birds, as also the almost unrestricted trapping and snaring of ground game, antelope and gazelle is doing enormous damage all over the country to the inherited wild life resources of the Republic of India

All these and various other matters are within the purview of this first admirable Resolution

> Where there is no vision the people perish, '— The first necessity, if man is to study life is to cease to destroy it "—"Constitutional and legal provisions are meaningless unless they are enforced — Can there be anything more humiliating to a Government than that it should make laws which are violated at the discretion of the people—and the violators not punished '

All these utterances have direct bearing if the labours of scientists are to have desired results

Education The next four resolutions deal with the fundamental importance of the widest possible distribution of educational material—films, books, leaflets, attractively designed and illustrated booklets as produced in such profusion in some western countries, the necessity that the organizations concerned with the protection of nature and conservation and utilization of resources should collaborate to the greatest possible extent, the great importance of encouraging youth movements in favour of nature protection and conservation such as already exist in a number of countries India has none of these It is the aim of I U P N to take steps to bring into being in all countries youth clubs devoted to the study and conservation of Nature, the promoting of international Fellowships for study and training in countries with a highly developed conservation science and technology is envisaged

Primary and secondary schools The sixth resolution resolves

> That the International Union for the Protection of Nature recommend to UNESCO that it informs governments of the vital need for the introduction of the teaching of the principles of nature protection and conservation in the curricula of primary and secondary schools and of universities and technical colleges, either as special courses or as part of existing ones related to the subject matter '

That is of the utmost importance, as has been urged by the present writer for 'the youth of to day must become the conservationists of to morrow"

In America the adoption of a 'conservation pledge' has had great results Such a pledge might well be adopted by all youth organizations and for nature study classes

CONSERVATION PLEDGE

"I give my pledge
as a citizen of the Republic of India
to save and faithfully to defend from
waste the natural resources of my country,
its soil and minerals, its forests, waters
and wild life"

Large scale projects The next resolution envisages the promotion, in connection with large scale projects, of co-operation with one or more of the organizations executing such projects, detailed ecological surveys which would furnish at the same time the most vital data in regard to those developments on the overall living environment in the areas affected, and valuable information to guide the development of similar projects.

This is of course, as are all the others also, a very important matter Agriculture, malaria, fish supplies, afforestation and other aspects of human ecology are all concerned Co operation, exchange of ideas and experiences are most valuable in connection with all large scale undertakings such as are in view in India at the present time

Insecticides Resolutions 8, 9, and 10 deal with the use and misuse of insecticides, the effective regulation of their use, as also of fungicides, herbicides, rodenticides for the protection of human interests, the object being to protect the equilibrium of nature by preventing the destruction of animal and plant communities It is declared that proposals should be worked out, and transmitted to a co-ordinating body such as a "permanent Joint Commission on Insecticides" to be formed by FAO, WHO and UNESCO

Resolution No 11 deals with treatment of cattle in Africa against trypanosomiasis and does not concern India So, also, No 14 No 19, and No 20, do not apply to this country

Exotic Species Resolution No 12 recommends to governments submission of their plans for importation of exotic species of animals and plants for approval of one of the scientific services dealing with nature protection and conservation, and has special reference to creation of parks for exotic animals, industrial breeding projects (fur animals etc), and fish farming

This has interest for India and will attract attention of government departments concerned

Scientific Committees The I U P N resolves in No 13 that certain countries or groups of countries promote the establishment of scientific committees composed of a small number of naturalists or ecologists to supply the Union with information in the field of ecology, and the true situation in regard to the protection of nature This is of moment to all countries as providing the essential contacts for fulfilment of the objects of the Union

In India, at the present time, while all aspects of the protection of Nature are of great importance, perhaps it is erosion, afforestation and cattle fodder, conservation of fish in waters of all the rivers and streams and wildlife conservation which can claim priority

Vanishing Assets Considering that the world is faced with an increasing list of threatened and vanishing species of fauna and flora, the Conference resolves (No 15) that the I U P N should establish a "survival service" for the assembling, evaluation, and dissemination of information on, and the study of, all such cases in order to assist Governments and appropriate agencies in securing their survival

The next Resolution gives a partial list of threatened birds and animals, which include the Indian pink headed duck and the Indian rhinoceros, the Asiatic lion, and the Burmese brow antlered deer of which one race is found in Manipur, and further provides measures for maintenance of an open list of such rare and threatened species and promotion of such ecological research, and such measures as would be necessary and effective for their preservation

Resolution 18 deals specifically with the great Indian one horned rhinoceros and urges the Government of India to recommend to the Provincial Government of Assam to take such steps in collaboration with the I U P N as will protect and preserve the species, especially in the Kaziranga Sanctuary which should be set aside as an inviolable Rhinoceros Sanctuary

Resolution 17 recommends immediate and vigorous action by Governments in respect to rare and threatened plant species and maintenance of an open list in respect to them

Food Resolution No 21 referring to the Beirut, 1948 Session of UNESCO, states that conservation of food resources is one of the primary responsibilities of FAO, and points out that the I U P N brings together specialists of various countries who are concerned with the fundamental scientific problems of conservation It further makes clear that the function of UNESCO in a world wide programme of food resources should be determined between UNESCO and FAO, and that the educational and basic scientific aspects of such a programme should be given special consideration by UNESCO

It also suggests that it would be to their interest to consult I U P N, and that the latter should receive from FAO and UNESCO all necessary documentation and information pertaining to their work in the field of conservation

SUMMARY

Scientists in all the many fields of modern research having perused and studied the above, will perhaps be more than ever brought to realize the importance of their labours in the cause of humanity and the better use that can be made through their conclusions of the ' preservation of the earth's renewable natural resources of which it is composed and on which rests the foundation of human civilization"

CONCLUSION

In respect to all the many matters dealt with, satisfactory results cannot be achieved by Government efforts alone The people also have their responsibilities, and unless these are whole heartedly and willingly discharged any amount of effort on the part of the Government cannot have adequate results

Therefore it is that the future well being of the peoples of the Republic of India rests with the scientists, the Government, and the people themselves—the people in every class of life and in every occupation and pursuit and in all this they have the wise counsels and invaluable support of the International Union for the Protection of Nature.

Notes and News

NATIONAL FUEL RESEARCH INSTITUTE

A large and distinguished gathering of Scientists witnessed the ceremony of the opening of the National Fuel Research Institute at Digwadih (10 miles from Dhanbad) by the Hon ble Dr Rajendra Prasad, President of the Indian Republic on April 22 last

Opening the Institute, the foundation stone of which was laid on November 17, 1946 (See *Science and Culture, 12*, 269, 1946), Dr Prasad said "as this Institute will work for the utilization of our coal resources in the best possible way, we can hope not only for a tremendous increase in the production of iron and steel but also a number of by products which we now import from abroad"

"While the total coal reserves of India were about 65,000m tons, of which 22,000m tons were considered workable, the output of good quality coal did not exceed 5,000m tons Not all of this again was suitable for metallurgical purposes Of the total annual output of all kinds of coal about 13m tons were of metallurgical type, but only 4m tons were being actually used for metallurgical purposes The position of coking coal reserves was also poor

"Coal of high volatile content other than of the metallurgical type has special uses in carbonization, by products recovery, synthetic production of oils gas manufacture etc

"The coal tar industry has a great future and is equally a necessity in view of our programme of extending roads Also a great variety of oils, high explosives, dyes, medicines plastics, antiseptics, insecticides, germicides, etc can be derived from coal tar Utilization and conservation of our coal reserves are absolutely necessary in the interests of the industrial development of the country, and this will depend on our ability to improve and utilize the inferior grades of coal and develop alternative supplies of different grades of coal for industries The by-products industry must also be developed

"The object of the Fuel Research Institute is to cover all aspects of research, both fundamental and applied, in solid, liquid and gaseous fuels, although for the present the activities of the Institute will necessarily be confined to a large extent to solid fuels"

The President said that the Institute would be able to count on support not only of the Government but also of the large and influential body of industrialists Similarly the universities would also help it by supplying research workers

The scope and functions of the Institute as envisaged in the report of the Fuel Research Committee of the Council of Scientific and Industrial Research was reported earlier (See *Science and Culture, 12*, 33, 1946), and will for the present be distributed among the following main divisions Coal Survey and General Analysis, Carbonisation and by products, Liquid fuel (including hydrogenation, synthetic fuels, petroleum and substitutes), Physics (including X ray and Sepectroscopy), Gaseous Fuels (including gasification), Engineering (including preparation of coal for the market, coal-washing, boiler plant and combustion engineering)

There will be six Regional Coal Survey Stations working under the Institute for the physical and chemical survey of coals and will be located at the Raniganj coalfield, with a laboratory near Disherghar, the Jharia field with its laboratory at the Central Institute at Digwadih, the Bokaro Ramgarh Karanpura fields with a laboratory at Ranchi, the Eastern States coalfields (Vindhya Pradesh) with a laboratory at Umaria, Sagra Estate the Madhya Pradesh (C P) coalfields, with a proposed laboratory at Kamptee near Nagpur, and the Assam coalfield with a proposed laboratory at Dibrugarh

The Institute has been functioning since 1946 when Dr A N Lahiri joined as Asst Director Dr J W Whittaker was later appointed Director of the Institute

ROCK SALT DEPOSITS OF MANDI

Reserves of salt in the Mandi area are estimated at 70 million tons If an igneous extrusive origin of these deposits be accepted the reserves may be several times this estimate

The average annual production of salt from Guma, Darang and Maigal is only about 100,000 maunds a year The Guma deposits are best worked by driving bore holes and recovering saturated brine Darang salt is inferior to Guma salt, mining can be done only by judicious "open" operations In the Maigal area where brine springs exist, 1,000 maunds of salt can be produced per day The brine is 99 per cent pure, and could profitably be used in the manufacture of salt by solar evaporation

The setting up of a refinery at Maigal producing 60 tons of white granular salt per day, employing a thermo-compression unit, is estimated to cost Rs 15 lakhs. Salt could thus be produced at Rs 15 to Rs 20 per ton A larger plant could be erected at Jogınder Nagar with brine supply from Guma

The combined output of salt from these sources is calculated to meet the requirements of Punjab(I) and the western districts of the U P ((*Jour: Sc Indus Res Ind* April, 1950, p 119)

ANCIENT COINS ACQUIRED FOR NATIONAL MUSEUM

The Government of India have recently acquired for the National Museum a rare collection of 1691 Sassanian coins of which 1664 coins are silver drachmas The collection was the life work of the late Mr F D J Paruck who was one of the greatest authorities on this class of coins in his time There are five other big collections of Sassanian coins namely British Museum Bibliothique Nationale Berlin Museum Ermitage Meseum Leningrad and the Zubov collection in the Historical Museum Moscow

The Paruck collection represents coins of 32 Sassanian sovereigns ranging from the second emperor Shahpur (211 12 A D) whose coins are extremely rare to Yezdegard III (632 651 A D) The collection is unique in this respect and also in that it represents a total of 102 mint marks the biggest in any collection In all 1322 coins bear dates From the time of Kobad I (488-497 and 499 531) when the years were given together with the mints up to the end of the reign of Yezdegard III (632 651 A D) the collection represents nearly all years and the greatest number of mints for every year

The present collection is weak in gold and copper coins but very strong in the silver series The legends on these coins are in the Pahlavi language and script and are composed firstly of regal titles secondly epithets in honour of the king and thirdly dates and the mint-monograms The coins of Shahpur III (383 88 A D) and Bahram IV (388 399 A D) display a model of neat Pahlavi writing

The Sassanian coinage apart from its representing the pre Islamic history of Iran is of positive interest to students of Indian history as Iran under the Sassanians and India under the Guptas were in close cultural and political contact resulting in the circulation of Sassanian coinage on the Indian mainland towards the west

The coins of Ardeshir (212 242 A D) show marked signs of a numismatic and an artistic renaissance and this revival continued till the reign of Shahpur II (310 379 A D) who was a contemporary of the great Gupta emperor Samudragupta From this period the Sassanian coins exhibit decline in artistic workmanship until during the reign of Khusro II a sort of artistic renaissance is again noticed on coins Of individual items in the collection those representing Khusro II (590 620 A D) are of great charm showing the turreted crown wings crescent and star in the head dress This emperor is said to have exchanged embassies with the Chalukya king Pulikesin of the Deccan in the beginning of the 7th century of which the scene of the Iranian embassy in the paintings at Ajanta furnishes the proof

Another set of valuable material from coin moulds consisting of several thousand fragments which the late Dr Birbal Sahni the distinguished palaeo-botanist discovered in 1936 at Khokra Kot near Rohtak will be deposited in the National Museum of India Mrs Savitri Sahni will present them to the Prime Minister

The material formed the basis of an interesting monograph by the late Dr Sahni on the technique of casting coins in ancient India It was at a mint town of the ancient republic of the Yaudheyas Bahadhanyaka in East Punjab that the mould fragments were found by Dr Sahni Some of the coupled discs still bear coins in their matrices They belong to roughly the second first century B C and exhibit a complex and efficient system of multiple disc moulds which became known to the Roman world only in the early centuries of the Christian era

NOVA LACERTAE 1950

A message has been received at the Harvard Observatory on January 25th last from Copenhagen that a 6th *magnitude nova was discovered on January* 23rd It is found by Charles Bertaud of Meudon Observatory France in the position $22^h\ 48^m$ 0+53°2

The visual estimates of the nova s brightness made by three astronomers at Washington show magnitudes of 6 3 6 5 and 6 1 The nova has been found to be of the same brightness up to 30th January On 5th February the nova has faded about half a magnitude and on 7th February it is estimated to be 7 2

Meanwhile Dr Dean B McLaughlin reported that in spectra taken on January 27th and 28th at the University of Michigan Observatory the general appearance was like that of Nova Herculis 1936 two weeks after maximum light but the bright bands were wider and the absorption lines more displaced At Harvard s Oak Ridge station Dr Armin J Deutsch procured spectra with the 61 inch Wyeth reflector He found the Balmer lines complex in nature with the emission components having total widths corresponding to velocities of about 1 800 kilometers per second The interstellar H and K lines of ionized calcium were strong (*Sky and Telescope* March 1950)

ISOTOPIC TRACER FOR FOODSTUFFS

To determine minute traces of fumigants and other insecticides present in treated foodstuffs and in insects work has been started on the use of radioactive materials A special DSIR laboratory has been equipped and initial experimental work has been carried out with the fumigant methyl bromide labelled with radioactive bromine of half life 34 hours (Br^{82})

It was first necessary to work out all the details for its synthesis on the millimole scale under conditions suitable for radioactive material Yields of about 90 per cent theoretical were eventually obtained the product having a boiling point within O I C of the theoretical value boiling point being taken as the criterion of purity This method is now in use for the preparation of radioactive methyl bromide from active potassium bromide prepared in the atomic pile at Harwell. (*The Chemical Age* February 25 1950)

DIHYDROSTREPTOMYCIN

The recent report of the Glaxo Laboratories states that dihydrostreptomycin is prepared synthetically by the catalytic reduction of streptomycin Like the parent substance dihydrostreptomycin is a base capable of forming salts, of which the hydrochloride and sulphate are the commonest

The importance of this new drug lies in its lower toxicity There is a growing amount of evidence that this chemical modification of streptomycin considerably reduces the drug's toxicity without altering its antibacterial activity or its therapeutic efficiency

Thus, by using dihydrostreptomycin the ordinary course of treatment may be prolonged and the dosage increased without neurotoxic symptoms appearing It has been stated that a total course involving as much as 90 gm of the drug can be injected in some cases without vestibular dysfunction occurring

When dihydrostreptomycin was first introduced, intrathecal administration of the compound was not recommended It is, however, apparently safe, states the report to administer dihydrostreptomycin sulphate by the intrathecal route in doses of 25 to 50 mg and it has recently been given intrathecally in full dosage without any untoward effects These findings apply only to the sulphate and should not be taken as applicable to the hydrochloride until more information about the compound has been obtained

Dihydrostreptomycin sulphate appears to cause less pain on intramuscular injection than does streptomycin (calcium chloride complex) and this is attributed more to the absence of calcium chloride than to the nature of dihydrostreptomycin itself Both compounds have, with a few important differences, similar properties, they are equally potent and stable and are effective against the same range of organisms Unfortunately, bacterial resistance to both drugs is said to be acquired with equal facility, development of resistance to the one involves simultaneous development of resistance to the other (*The Chemical Age*, March 18, 1950)

CORTISONE AND ACTH

The discovery of the remarkable effectiveness of cortisone in the treatment of rheumatoid arthritis is very significant The convenient abbreviation 'ACTH' has been appearing in the literature dealing with these researches with increasing frequency during the last few months It stands for *adrenocorticotropic hormone*, and is a material which has been shown to produce as excellent a response as cortisone in rheumatoid arthritis patients The two drugs are linked biochemically in the following manner The outer portion of the adrenal glands—the *cortex*—produces a number of different hormones, including cortisone, which are secreted into the blood and have various inportant actions Almost thirty different compounds of the class known as 'sterols' (which are alcohols of high molecular weight)have already been isolated from the adrenal cortex, although not all appear to be active physiologically The adrenal cortex can be stimulated to produce increased amounts of the cortical hormones by a special hormone, the hormone already mentioned and known as ACTH, which is secreted by the pituitary gland Administration of ACTH can thus produce indirectly results similar to those following injection of cortisone, although ACTH may produce other effects as well, as it seems to stimulate production of the other cortical hormones besides cortisone Clinical experience has shown that ACTH is an extremely powerful drug and must be administered with great care as it can cause unfavourable side effects ACTH is being made in the Armour Laboratories in Chicago at the rate of 60lb a year from hog's pituitaries, which is sufficient for the treatment of 2000 4000 patients

ACTH is a protein, owing to the size and complexity of its molecule, a complete determination of the structure and a synthesis is beyond the scope of organic chemistry at present However, Dr Chor Li of the University of California has shown that the large molecule can be broken down into smaller and simpler fragments, called peptides, some of which retain the original activity He has in fact obtained one such peptide that is 16 times more potent than ACTH, and it may prove possible to synthesise this substance (*Discovery*, March, 1950)

STREPTOMYCIN PRODUCTION IN U K

The successful development in streptomycin production is one of the most outstanding achievements in the pharmaceutical industry in U K Glaxo Laboratories started pilot plant production of this potent antibiotic in 1948, after its discovery by the American Mycologist, Dr S A Waksman, in 1944

Many of the manufacturing processes follow the same pattern as of penicillin and part of the penicillin equipment is utilised in streptomycin production Up to and including the fermentation stage the processes are identical Streptomycin production begins in the 'Spore form", where microbiological preparation of streptomycin cultures is carried on alongside penicillin The inoculum is grown in a one-litre shake flask and passes through a series of tanks of gradually increasing size—initially the 50 and 500 gal units and finally large 5000 gal fermenters for large scale fermentation

Streptomyces griseus, the micro organism which produces this antibiotic, grows best on a rich protein diet (*e g*, meat extract) instead of the relatively inexpensive corn steep liquors used in penicillin production. One of the microbiological problems involved in streptomycin has been the production of a more economical, and at the same time more nutritive, medium

When the fermentation stages are complete, filtering of the broth removes the mycelium and unwanted solids The mycelium from streptomycin unlike that of penicillin, is like thin tissue paper Streptomycin is extracted by an adsorption process—where it differs radically from penicillin —and is converted to crude hydrochloride This is in turn converted by a crystallisation process to calcium chloride salt The calcium chloride is decolorised, Seitz filtered and freeze-dried in bulk

Many hundreds of samples of streptomycin are tested biologically, chemically and pharmacologically for potency and sterility and then the drug is ready for filling and packing operations (*The Chemical Age*, February 18, 1950)

PERMANENT GLOSS STANDARDS

Permanent gloss standards, covering the entire gloss range of nonmetallic commercial materials, are now available from the National Bureau of Standards These standards, which may be used to calibrate any 60 degree specular glossmeter in the range from matte to high gloss, are made of ceramic materials for permanence, and the surfaces have been specially chosen for similarity to commercial materials whose gloss is important

The gloss measurement is essentially a simple one When a specimen is illuminated at some angle from the perpendicular, the proportion of the light reflected at angles near that of mirror reflection is defined as gloss A critical part of the definition of gloss is the amount that the reflected beam may depart from the strict direction of miror reflection and still be counted as contributing to gloss With glossmeters commercially available at the present time, replacement of the lamp may introduce instrumental error unless readjustment is made The new gloss standards permit a rapid check of instrument calibration at any time and give a basis for redjustment of the instrument if required A set of gloss standards consists of two white vitrolite plaques having nominal gloss values 1 and 90, and eight glazed ceramic plaques with nominal gloss values 10, 20, 30 40, 50, 60, 70, and 80 all 4¼ inches square The plaques are calibrated with the gloss reference standards of the National Bureau of Standards These measurements include both the true gloss and diffuse reflectance component (*Journal of the Franklin Institute*, February, 1950)

ACTINIUM PRODUCTION

The first industrial production of the rare radioactive element actinium has been made by Boris Pregel at the International Rare Metals Refinery, Inc New York Actinium, the last of the natural radioactive elements to be isolated in commercial quantities, is about 150 times as active as radium and so it is of utmost value in the production of neutrons (*Journal of the Chemical Education*, February, 1950)

COPPER WATER PIPES

The British Non Ferrous Metals Research Association has for several years been studying the behaviour of copper in supply waters. Recent work has revealed the main cause of the pitting type of corrosion which occurs occassionally in cold water pipes. The report of the association indicates that (1) there is no evidence to establish the superior corrosion resistance of either of the two grades of copper allowed by the British Standards for Light Gauge Copper Tubes for water, gas and sanitation and for copper tubes to be buried underground The two materials—phosphorus-deoxidised non arsenical copper and phosphorus-deoxidised arsenical copper—are equally satisfactory in service provided they are both free from carbonaceous films, (2) the pitting corrosion of copper cold water pipes sometimes experienced in certain waters is usually due to the presence of carbonaceous films which may be produced inside the tubes by some manufacturing conditions, (3) pitting corrosion of copper pipes does not occur in the majority of supply waters in this country, even if carbonaceous films are present, and (4) the effect of carbonaceous or other films on the serviceabilityof copper tubes in hot water systems is not clearly known

Two types of corrosion of copper water pipes are observed 'Green staining" and Pitting corrosion" Green staining in baths, wash basins, etc is occasionally experienced with waters containing a high proportion of free carbon dioxide Pitting corrosion may cause failure of copper pipes by pinhole leaks, but has only been known to occur in a small number of supply waters Most supply waters contain a natural inhibitor which prevents pitting (*Water and Water Engineering*, March, 1950)

DRAFT STANDARD FOR STEAM CYLINDER OILS

The Chemical Division Council of the Indian Standards Institution has formulated the following six draft Indian standard specifications for steam cylinder oils with the object of providing for the entire range of the varying requirements of lubrication of steam cylinders pure mineral, ordinary, compounded, ordinary, pure mineral, superheat, compounded, superheat, pure mineral filtered, and compounded, filtered

In each specification, general indication has been given of the service conditions under which the respective grade of oils is to be used The standards prescribe the requirements for the flash point, kinematic viscosity, total acidity, inorganic acidity, setting point, carbon residue, ash, sulphur (corrosive), specific gravity saponification number, and hard asphalt (asphaltene content)

The limits for hard asphalt have been included in the draft Indian standard specifications for pure mineral, superheat and filtered pure mineral cylinder oils only Similarly the saponification number has been prescribed for compounded ordinary, compounded superheat and compounded filtered cylinder oils. Those drafts have been circulated to members of the Institution interested in this field and to large consumers, manufacturers and technologists concerned for favour of approval

BOTANICAL SOCIETY OF BENGAL

The Fourteenth Annual General Meeting of the Botanical Society of Bengal was held on Saturday, the 25th March, 1950 at the Baker Laboratories, Presidency College, Calcutta Dr K Biswas, Superintendent, Royal Botanic Garden, Sibpur presided and

H E Dr K N Katju Governor of West Bengal was the Chief Guest on the occasion

Speaking on the occasion Dr Katju said it was desirable that Indian scientists should make available in popular language to the common man whatever investigations made and whatever new sources of knowledge they explored

Scientists, he said should help the Government to tackle the urgent problems of the country The world today was facing a crisis People everywhere felt uncertain about the future in India they were in the grip of fear and anxiety

Increased supplies of food and medicine was needed in the country to meet their needs Scientists must help in this hour of national crisis to find means to produce more food and better medicines

The Governor also referred to the importance of investigating the medicinal plants in India Scientists would be conferring a lasting benefit on the masses if they could unravel the hidden powers of these plants In this work they would have the active support and sympathy not only of the Government but of various pharmaceutical firms

Reviewing the affairs of the Society Dr K Biswas, who presided referred to the need for the investigation of indigenous medicinal plants and also foreign ones which could be cultivated and acclimatized in India He said "Investigation of medicinal plants depends mainly on the four aspects of researches namely—(1) Systematics including Taxonomy and Ecology of medicinal plants, (2) Introduction Acclimatization and Cultivation of well known medicinal plants under various conditions in suitable areas of India with a view to producing the highest active principle, (3) Pharmaceutical and chemical assay of medicinal plants and (4) Clinical, that is application of vegetable drugs on animals and finally on man

"The importance of the investigation on medicinal plants was recognised by the then Government of India as early as 1894 with the formation of Indigenous Drug Committee which was superseded by Indigenous Drugs Manufacture Committee in 1930 which recommended addition of 3 botanists, 3 Assistants and other staff to be added to the Botanical Survey of India Department But that was only a paper resolution and Sir Ram Nath Chopra stressed the importance of reviving the activities of such a Committee in 1933 and for the nationalization of indigenous drugs

"The present need of our country is to investigate all indigenous and foreign medicinal plants mentioned in Ayurvedic and all old and modern literatures which admit of acclimatization and cultivation in India. Botanical, chemical and clinical experiments should be carried on hand in hand for each and every plant having some potency in curing some diseases. Those which will be found from experiments to be the most efficacious ones should be cultivated on a large scale in suitable places and the medicines should be manufactured in proper form by isolating the active principles on modern scientific lines.

"Examination of the list of medicinal plants now in demand by the chemists and pharmaceutists show that 48% of the plants for the pharmacological trade can be grown in suitable areas of the Darjeeling District alone and 20% in the plains of Bengal Consequently, all the possibilities should be explored with a view to making this venture in this province a success that it deserves The success is well assured as sufficient suitable land for large scale cultivation of these medicinal plants is already available in the Cinchona areas of the Darjeeling District The technical personnel who have already made experiments and thus have acquired considerable experience in the line are also at hand and up to date laboratory, the manufacturers and the markets dealing with the vegetable drugs are all located in Calcutta"

Dr K Biswas was re elected *President* of the Society for the year 1950 51

SOAPLESS 'SOAP TO DISSOLVE THE INSOLUBLE

A number of chemicals—washing nuts, for example—possess typical properties of soap without in any way being chemically related to ordinary soaps These newer detergents have of late assumed industrial importance and their prices have been brought down to fairly competitive levels

A special property of these detergents is their power of dissolving an otherwise insoluble substance This phenomenon is called solubilization For example, they can make oil mix with water to a perfectly clear solution Research to discover how much water dissolves in oil and other organic solvents by use of a definite quantity of a detergent is being undertaken by the Indian Association for the Cultivation of Science in Calcutta

The Association is also investigating the possibility of preparing cellulose acetate, an important article of commerce and one that is used extensively in lacquers, plastics and rayon in good yield and of good quality from Indian cotton

The process, in short consists of treating cotton with sulphuric acid, glacial acetic acid and acetic anhydride to obtain what is technically called a primary acetate This is subsequently transformed into the secondary cellulose acetate of commerce by adding regulated quantities of water to acetylating bath. Comparison of products at every stage with similar products obtained from Egyptian cotton has shown that it is possible to obtain good quality cellulose acetate from medium staple Indian cotton by a rather easy process

CONFERENCE ON PHYSICS OF THE IONOSPHERE

The Pennsylvania State College, U S A, organised last year a conference on "Ionospheric Research" in which many ionospheric workers from different parts of the world participated The conference is reported in the September 1949 issue of the *Journal of Geophysical*

Research. In view of its apparent success a similar conference is being organised this year under the joint auspices of the Pennsylvania State College and the Geophysical Research Directorate of the U S Air Forces The conference will be held on July 24, 25 26, 1950 Leading scientists in the field from several countries have been invited to join the conference Dr S K Mitra of the University of Calcutta, and one of the Editors of SCIENCE AND CULTURE who had been invited to the last year's conference but could not attend, has again been invited this year and arrangements are being made to fly him by the U S Military Air Transport Service to Boston, Massachusetts

Dr Mitra has been requested to initiate the conference with a paper on the "Physics of the Upper Atmosphere" It is expected that several speakers will discuss the results of the upper atomospheric measurements from V 2 rocket flights

ANNOUNCEMENTS

Dr J C Ghosh, Director General of Industry and Supply has been appointed Director of the Eastern Higher Technical Institute, Hijli (West Bengal) The Institute with its buildings and equipment, is estimated to cost over Rs 1 crore The annual recurring expenditure will be Rs 30,00,000

Sri S K Mukherjee, Lecturer in Botany, Delhi University has been admitted to the degree of Doctor of Science of the Calcutta University for his thesis on "the Origin, Distribution and Systematics of the species of *Mangifera* L" The thesis was adjudicated by a Board of Examiners consisting of Dr N L Bor, Assistant Director, Royal Botanic Gardens, Kew and Dr E D Merrill and Dr R Ruggles Gates, F R S of the Harvard University, U S A

Sri M C Malakar, working under the Indian Council of Medical Research at the Nutrition Research Unit at the University College of Science and Technology, Calcutta has received the degree of Doctor of Science (*Tres Honorable*) of the University of Paris for his thesis on "The Biochemical and Physiological Studies of Palm-oil Cake"

The Government of West Bengal has made a grant of Rs 8,400/- only to the Engineering Geology Labotory of the College of Engineering and Technology, Jadavpur for carrying out investigations on the constitution of the sub-soil samples of the Contai sea beach with a view to instal a large scale salt factory in the area It has been estimated that five million maunds of salt would be manufactured in this area and the French salt experts are busy in working out the project

At the Tenth Annual General Meeting of the Science Club, Calcutta, held on April 23, 1950 at Panihati under the Chairmanship of Sri S P Sen, General Manager, B C P W the following were duly elected office bearers for the year 1950 51 *President* Dr K R Sen, *Secretaries* Sri A K. Ghosh and Dr T K Ghosh

The following were duly elected office bearers of the Calcutta Branch of the Zoological Society of India, at a meeting held in Calcutta on April 28, 1950 *Chairman* Dr J L Bhaduri, *Secretary* Sri B Biswas

Elsewhere in this issue we have published an appeal for donation to the "Acharya Prafulla Chandra Memorial Fund" The Honorary Secretary of the Indian Chemical Society gratefully acknowledges further receipt from the following

Bengal Potteries Ltd, Calcutta Rs 5000/ Teddington Chemical Factory Ltd Bombay Rs 1000/ Scientific Instrument Co, Calcutta Rs 204/ Chemical Industrial & Pharmaceutical Lab Bombay Rs 200/ Raj Der Kar & Co, Bombay Rs 101/ Standard Pharmaceutical Works Ltd, Calcutta Rs 100/ Scientific Glass Apparatus Mfg Co, Calcutta Rs 100/ Dr T M Oza D Sc, Ahmedabad Rs. 51/, British Drug House (India) Ltd, Bombay Rs 50/

Total receipts so far amounts to Rs 51,792/

A Conference on the Properties of Semi conducting Materials will take place at the University of Reading from July 10th to 15th, 1950 The Conference, which is assisted by UNESCO, will be under the auspices of the International Union of Physics, in co operation with the Royal Society, and will be organised by Professor N F Mott and Professor R W Ditchburn The subjects of discusion include the conductive properties of non metallic solids, photo conduction barrier layer rectifiers, crystal triodes etc, and the relevant theoretical issues General prospectus can be obtained from the Secretary Dr H K Henisch, Department of Physics, The University, Reading, England

ERRATA

In the April, 1950 issue (i) On p 396, column 1, line 22, *read* Aryan Home *for* Arger have (ii) On p 400 column 1, line 12 *read* 1930 for 950 (iii) On pp 400 and 401 *read* Z_A and Z_B *for* ZA, ZB and Z^A or Z^B, r *for* γ (in the table) and μ *for* h (iv) On p 402, column 1, line 30 *read* purplish *for* purplih

LETTERS TO THE EDITOR

[The Editors are not responsible for the views expressed in the letters.]

LEAF AREA IN SUGARCANE AND ITS RELATION TO THE APPLICATION OF INSECTICIDES

As mostly understood and followed at present the amount of insecticide required for the control of crop insect pests is a product of dosage and the ground area. In giving the directions the dosage of the insecticide per unit of ground area is given with a small range of dosage and dilution details etc. According to Potter[1] the dosage of 5% DDT required for dusting in the control of sugarcane froghopper (*Tomaspis saccharina* Dist.) in British Carribean is 50 lbs of dust per acre. According to this schedule the quantity of 5% DDT required in the control of the above insect pest on an area of 4 acres of sugarcane crop will be 4 × 50 or 200 lbs in that place.

In the control of leaf sucking and leaf eating insect pests it is the total leaf area and not the ground area that is to be covered which is of importance but which is generally not taken into account. The leaf area is a highly variable factor and some observations done on the *Adsali* (monsoon planted) sugarcane crop in this tract has confirmed this. As a rational method it is suggested that before taking up the dusting or spraying operations for leaf sucking or leaf eating insects, an attempt should be made to find out the total leaf area of the crop to be covered. In sugarcane crop this can be arrived at by finding out the stand of the crop and the average total leaf area of the individual plant by suitable sampling methods. This would help in the correct usage of the isecticide and wastages if any can be minimised.

Further details will be published later. Thanks are due to my colleague Sri A. S. Rao, for help and suggestions.

D. V. MURTHY

Sugarcane Entomological Laboratory,
Department of Agriculture,
Bodhan, Hyderabad (Deccan)
22.12.1949

---

[1] Potter T. E. K.— *Plant Protection Overseas Review 1*, 2, 22-29, 1949.

A NOTE ON THE SPECIFIC VOLUME AND THE POROUS STRUCTURE OF JUTE

Hermans[1] has dealt at length with the specific volume of cellulose fibres in solvents and water. He has established that, in the case of ordinary cellulose fibres, including rayons, the specific volume in a solvent, say carbon tetrachloride, is the true specific volume the liquid penetrating all the void spaces including lumens (i.e., spaces of larger than molecular dimensions) but not being able to penetrate the cell walls and hence the molecular spaces between the cellulose chains. As a proof of his theory he has found that specific volume of various cellulose fibres decreases with the increase in the crystalline fractions. He has also shown that the apparent specific volume in water for cellulose fibres is the result of penetration of water into the cell walls on account of the molecular attractions and that it is not necessary to suppose compression of water to explain decrease of specific volume when water is used as a medium.

On the basis of Hermans theory and using the specific volume figures for jute due to Macmillan and Sen[2], and those for pure cellulose native fibres as given by Hermans some deductions can be made regarding the porosity of jute fibres. The specific volumes are given in the table I.

TABLE I

Medium	Specific Volume	
	Jute	Cotton or Ramie
Carbon tetrachloride	0.696	0.645
Water	0.641	0.611

The difference in the figures for jute and pure cellulose cannot be due to lack of penetration of solvent in the lumen area because on actual observation under the microscope it has been noted that solvents penetrate into the lumens of jute.

The only explanation that can now be put forward is that the solvent penetrates the lumen area but fails to do so into some other void spaces in the fibres. That water penetrates these areas is evident from a comparison of the specific volume of jute in water with that of cotton or ramie in carbon tetrachloride. It is, therefore, required that these void spaces are composed of hydrophilic structures. Comparing the specific volumes in water for jute and cotton or ramie, it will be seen that the cell walls of jute are more inaccessible to water, which may be due to less swelling in water.

The excess volumes (cc) relative to cotton for 100 gms. of jute and rayon are as shown in the table II which indicates that the void space in jute is much greater than that in rayon.

TABLE II

Fibre	Solvent	
	CCl_4	H_2O
Jute	5.1	3.0
Rayon	1.6	0.9

According to Hermans, the excess volume in the case of rayon is due to the presence of a greater proportion of amorphous cellulose compared with cotton The total percentage of crystalline cellulose in jute as determined from the background analysis of the X ray diagram by Sen and Hermans[3] is about the same as in rayons, *i e*, α cellulose content of 60% with 70% crystalline cellulose makes 42% total crystalline cellulose as against 39—40% for rayon The cause of the void spaces in jute is, therefore, to be sought in some other factor besides amorphous cellulose It is possible that lignin in combination with hemicellulose produces such open structures located, perhaps, in the regions including and bordering the middle lamella Indication as to its possibility has already been obtained in the swelling and staining experiments [3,4] of jute fibres

M K Sen

Indian Jute Mills Association
Research Institute, Calcutta
1 2 1950

Hermans Contribution to the Physics of Cellulose fibres Macmillan and Sen *J Text Inst 32* T45 1941
Sen and Hermans Rec Trav Chim (being published)
Sen and Woods Biochim Biophys Acta (being published)

MEASUREMENT OF ATTENUATION CONSTANT OF SOIL AT ULTRA HIGH FREQUENCIES

While performing experiments on the conductivity and dielectric constant of soil at ultra high frequencies with Lecher wires,[1,2] it is often found necessary to make proportionate approximations in the measurement of wavelength of propagation of the wave through the soil and in the 'half width' of resonance curves for calculating the attenuation constant of the soil This is due to the length of the box containing soil, which does not always completely cover exactly half of the wavelength measured in the soil Further, the direct measurements of the above quantities in the soil are also not very convenient without disturbing the packing of the soil contained in the box It was thus found useful to investigate the validity of such approximations for different lengths of the soil box

For the above purpose, measurements of attenuation constant of the soil were made for various lengths of the soil box on ultra-short wavelengths between 4 and 6 metres in air and the results were compared with the values obtained by direct measurements in the soil It has been found that such approximations are valid when the length of the box is such that the far end of the soil as seen from the input side is fairly away from the first current antinode formed on the Lecher wires outside the soil box The discrepancy between the calculated and observed values, which is presumably due to reflections occurring at the boundary of the soil, is found to be much less when the length of the box ends near the first current node situated outside the box

Table I below shows the values of attenuation constant (α) of soil for different lengths of the soil box, calculated from the relation,

$\alpha = 2\pi d/n\lambda^2$, where
d = proportionate 'half width' of the resonance curves
n = number of current antinode at which observations are made,
and λ — wavelength in soil

TABLE I

Wavelength in air = 4 0 meters
Wavelength in soil = 2 2 metres
Attenuation Constant directly measured in soil = 0 428

No	Length of Soil Box in cm	Calculated Attenuation Constant	Remarks
1	180	0 424	——
2	160	0 535	Near Current Node
3	140	0 449	——
4	120	0 821	Near Current Antinode
5	60	0 528	Near Current Node

It will be observed from the above table that the discrepancy between the observed attenuation constant, as measured directly in the soil and the calculated value, from proportionate half width of resonance curve, is more pronounced near current antinode as shown in the fourth observation of third column of the table The discrepancy is however much less when the length of the soil box ends near the current node as shown in the first and fifth observations in column 3 It may be noted that similar observations have been recorded on other wavelengths between 4 and 6 metres and the calculated attenuation constant always shows an enhanced value compared to the value directly measured in the soil

The above work was done in the Banaras Hindu University and the author s grateful thanks are due to Dr S S Banerjee for his helpful suggestions during the progress of the investigations A detailed paper will be published elsewhere very shortly

P N Sundaram

National Physical Laboratory of India,
Hill Side Road,
New Delhi 3 2 1950

[1] Banerjee S S and Joshi R D *Phil Mag 25* 1025, 1938
[2] Smith Rose R L and Mc Petrie J S *Proc Phys Soc 46*, 649, 1935

SYSTEMATIC SAMPLING II

This is in continuation of a previous communication[1] by the author which may be denoted as 'Systematic Sampling I In the present note, as in the previous one, we shall consider a two dimensional field consisting of ml rows of nk cells in mn strata each of size lk From this field we may take a random sample, a stratified sample or a systematic sample of size mnv in the same way as has been defined in the previous paper

Then defining σ_r^2, σ_{st}^2 and σ_{sy}^2 as the expected variances of the sample-mean under random, stratified and systematic samples, the following theorems can be proved for all infinite populations giving sufficient conditions

Theorem 1. If (i) $\Delta_1 \psi \leqslant 0$, (ii) $\Delta_2 \psi \leqslant 0$, (iii) $\delta_1^2 \rho \leqslant 0$ and (iv) $\delta_2^2 \rho \leqslant 0$, the relation $\sigma_{st}^2 \leqslant \sigma_r^2$ is true for any size of the sample,
where ρ is $\rho\,(u\ v)$ i e, the space correlation of gap $(u\ v)$ $\psi\,(u,v) = \rho\,(u\ v) + \rho\,(u,\ v)$, and Δ_1 and δ_1 are the usual difference notations

These conditions are independent of the conditions stated in Theorem 1 of the previous paper

Theorem 2 If stratification is made by parallel strips along u directions (say), $\sigma_r^2 \leqslant \sigma_{st}^2$ for any size of sample if (i) $\Delta_1 \psi \geqslant 0$, and (ii) $\delta_2^2 \rho \geqslant 0$

These conditions also are independent of Theorem 2 of the previous note

Theorem 3 If (i) $\delta_1^2 \rho\ (u\ v) \geqslant 0$ and (ii) $\delta_2^2 \rho\ (u,v) \geqslant 0$, the relation $\sigma_{sy}^2 \leqslant \sigma_{st}^2$ is true for any size of the sample and $\sigma_{sy}^2 < \sigma_{st}^2$ unless equality holds in each of the above two cases

Here it is to be noted that condition (iii) of Theorem 3 of the previous note is superfluous

Now, we may state another theorem as
Theorem 4 Under conditions of Theorem 1, the relation $\sigma_r^2 \geqslant \sigma_{st}^2 \geqslant \sigma_{sy}^2$ holds good

But from the theorems of the previous paper, we get a more stringent set of conditions for this relation

It has also been proved that Theorem 3 holds good even if the strata have got different expected means and variances

A C DAS

Department of Statistics,
Calcutta University,
20-2 1950

---

[1] SCIENCE AND CULTURE, *15*, 151 1949

PREPARATION AND STANDARDISATION OF ALUMINIUM OXIDE FROM THE LOCALLY AVAILABLE ALUMINIUM HYDRATE, FOR CHROMATOGRAPHIC SEPARATION

Tswett's method of chromatographic separation of natural and synthetic products has developed into one of the most essentials of the laboratory techniques, just like fractional distillation, fractional crystallization etc For different purposes different types of adsorbents such as, calcium hydroxide, silica-gel, Fuller's earth, bentonite, activated charcoal, synthetic resins etc have extensively been used Nevertheless, ***Aluminium oxide is still the adsorbent of choice***

During our investigations on *Mimosa* Hormone, we realised at a certain stage of purification, the technique of chromatographic separation would be the most effective one Due to the unavailability of standard aluminium-oxide at that time, our work suffered tremendously Combining the methods of Brockmann[1] and Dupont[2] we have prepared and standardised aluminium oxide of different adsorptive capacities from the locally available aluminium hydrate

"Anhydrous aluminium oxide, Al_2O_3 for chromatographic adsorption analysis by Brockmann" of E Merck, Germany has found extensive application on account of its *uniform adsorptive capacity* The aluminium oxide prepared and standardised by us according to Brockmann[1] is capable of covering a wide field of application and as such can very easily be used as substitute for the costly product supplied by Merck

The adsorption by the aluminium oxide depends upon a number of factors such as, grain size, water-content of the oxide, dehydration temperature, period of dehydration and the ions adsorbed on it Among all these factors that the water content of the oxide is the most vital, has definitely been proved by Taylor[3] The activity of aluminium oxide is directly proportional to the degree of dehydration of the aluminium oxide.

The sample of aluminium hydrate supplied was granular in nature, with slight reddish tinge due to the presence of traces of iron as impurity After a number of trials the grain size most suitable for chromatography was found to be 100 200 mesh We found that Brockmann's method[1] can effectively be employed for the preparation of aluminium oxide of Grades I and II whilst the method of Dupont[2] was found to be very efficient for Grades III, IV and V

Grade I Commercial aluminium hydrate was heated in small portions to red heat, in an iron crucible with occasional stirring and allowed to cool in a vacuum desiccator In our case, heating in a thin layer (0 25 cm to 0 5 cm) for 8 to 10 hours was found to be sufficient to reach the desired activity The sample so prepared transformed itself to Grade II when it was kept for half an hour in open air

Grade II Commercial hydrate was heated in a layer of 3 cm over a ring burner for 4 to 6 hours with very frequent stirring and cooled in a thin layer for about 30 minutes The sample so prepared was found to be more or less stable in open air

Brockmann's method of preparing Grades II, IV and V by the exposure of Grade II to moist air for different periods of time was found to be inconvenient and thereby Dupont's method[2] was applied for the last three grades.

Grades III, IV and V Commercial aluminium hydrate was heated at 500°C in an electric furnace for one hour After cooling it was transferred to a large flask, conc HCl was added to it and stirred so that a supernatant liquid layer was obtained It is kept for 2 3 hours, mixing up from time to time Then it was diluted with large volume of water After stirring and allowing to settle for 5 minutes, the supernatant layer was decanted off to remove the finer particles. The operation was repeated 5 or 6 times with large volume of water till the supernatant liquid clears up in 2 to 3 minutes.

In our case, only one operation was sufficient as the grain size of the sample used was 100 200 mesh Next the product was washed on a buchner funnel till neutral and put in an oven at 105°C When it began to dry up a small quantity was taken out from time to time and its activity was measured by the method described below Our sample reached gradually the activities of Grades V, IV and III in course of 8 12 hours but considerably longer period of heating was required to reach the activities of Grades II and I So Brockmann's method was chosen for the preparation of Grades I and II

TABLE

Grade of activated Alumina	Dye mixture used	Nature of the chromatogram
I	(1) and (2)	Separated on the column (2) forming upper band
II	(1) and (2) (2) and (3)	(2) remained adsorbed (1) passed through separated on the column (3) forming upper band
III	(2) and (3) (3) and (4)	(3)remained adsorbed (2) passed through separated on the column (4) forming upper band
IV	(3) and) (4) (4) and (5)	(4) remained adsorbed (3) passed through separated the column (5) forming upper band
V	(4) and (5) (5) and (6)	(5) remains adsorbed (4) passes through separated on the lumn (6) forming upper band

The following dyes were used by Brockmann (1) Azo benzene (2) p methoxy azobenzene (3) Sudan yellow (4) Sudan Red (5) p Aminoazo benzene and (6) p hydroxy azobenzene

All the dyes except Sudan yellow and Sudan Red were prepared and purified by us in our laboratory Sudan yellow or Benzol azo naphthol (m p 134°) and Sudan red (m p 184° when crystallized from ethyl acetate), commercially known as Sudan III were procured from abroad and purified by repeated crystallization Even after repeated crystallisation and attainment of sharp melting point by the dyes chromatographic adsorption of individual dye showed the presence of traces of impurities by the formation of a very fine band above the main band of the dye So all the dyes after repeated crystallization were purified chromatographically on activated Aluminium oxide In order to measure the activity of the alumina the separation of various dye mixtures were observed on column 1 5 by 10 cm For each test two dyes (20 mg each) were dissolved in 10 ml of purest benzene and diluted to 50ml with 40 ml of Petrol ether 10 ml of this solution were passed through the column followed by 20 ml of solvent (benzene +petrol ether 1 4) Behaviour of the dye mixtures observed is shown in the above table.

Thus it is observed that it is easily possible to prepare aluminium oxide of different grades for chromatography from the locally available sources and thereby we need not depend upon the supply of Brockmann's Alumina from abroad Further alumina of varying activities (most active to the least active one) are often required depending upon the nature of the substances to be chromatographically separated. And by the methods quoted above we can easily prepare Alumina of different specific activities suited to our varying requirements

Our sincerest thanks are due to our Director Dr D M Bose for his kind interest and encouragement which he extended to us during the tenure of this work Our best thanks are also due to Dr P B Sircar Ghosh Professor of Chemistry University of Calcutta for some valuable suggestions

We gratefully acknowledge the kind collaboration of Messrs Indian Aluminium Co Ltd for supplying us various samples of aluminium hydrate

Bose Research Institute D P BURMA
Calcutta 1 3 1950 B BANERJEE

[1] Brockmann *Ber* *74* 73 1941
[2] Dupont *et al* *Bull Soc Chim* p 785 1948
[3] Taylor *J Soc Chem & Ind* p 23 January 1949

SPAWNING OF *HILSA ILISHA* (HAMILTON) IN THE HOOGHLY RIVER*

The Indian Shad *Hilsa ilisha*(Hamilton) is known to ascend the large rivers of India during the floods for breeding and although artificial fertilization† of the eggs was carried out as early as 1908 [1] at Madras there has been very little information about its actual spawning grounds (except general inferences) and of its early development Prashad[2] in the course of his investigations on *Hilsa* threw additional light on the bionomics of the fish in Bengal and Hora[3] discovered post larvae and young of *Hilsa* from the filter beds and settling tanks of the Pulta Waterworks and indicated the Hooghly as one of the spawning grounds of *Hilsa* Later Hora and Nair[4] concluded that the fish breeds in the Hooghly River almost all the year round A series of postlarval stages from 14 mm to 27 mm collected from the Pulta Waterworks were described by Nair[5] We have recorded pro larvae of *Hilsa* collected from the Hooghly along with the early stages of the Gangetic Anchovy *Setipinna phasa* (Hamilton) From the 2nd of February this year we succeeded in collecting laid eggs (embryonic stages) of the *Hilsa* from the river in good numbers, in both the sub-surface and bottom hauls with plankton nets and observing the development, thus completing the life history stages of this very important food fish and definitely locating the river stretch in the vicinity of Pulta as one of its breeding grounds

---

*Published with the kind permission of the Chief Research Officer Central Inland Fisheries Research Station

† Dr S. L. Hora informs us that Dr C V Kulkarni of Bombay Fisheries Department has recently succeeded in artificially fertilising the eggs at Bombay

Ripe eggs examined from mature females were seen to be nearly spherical with a diameter of about 0 75 mm almost transparent and lightly demersal After oviposition water is absorbed and the *zona radiata* softens and expands to a diameter of about 2 mm, showing a wide perivitelline space and giving a characteristic double layered appearance in dead and preserved eggs The earliest development stage obtained from the river had the blastoderm as a cap of cells and such stages were obtained from 2 P M to 8 P M From the observations made so far it could be surmised that breeding usually takes place during day time

The yolk is segmented and has several oil globules which gradually coalesce to form a large conspicuous one with one or more very small globulets The subsequent development is typical of clupeids Hatching takes place in nearly 24 hours after the above stage at a temperature of about 23°C The hatchling is about 2 3 mm long lightly demersal and transparent with a few minute indistinct scattered chromatophores on the yolk The mouth and anal opening are absent The position of the anus is indicated near the 40th myotome On the second day the mouth opening is formed and the pigmentation is more distinct Some of the pigment spots may be seen to be concentrated at the anterior region of the yolk and others sparsely distributed on the main body of the yolk they being comparatively more numerous towards the dorsal aspect The complete development could be worked out by rearing the larvae in the laboratory and observing various developmental stages collected from the river The yolk is absorbed when the larva is about 8 mm in length and the adult characters begin to develop when it is about 30 mm in length The postlarvae feed mainly on diatoms and copepods and the young fish on both zoo plankton and phyto plankton The life history of the fish is being given in detail elsewhere

Since the completion of the above work it was possible to determine definitely the identity of certain eggs collected by one of us (S J) on September 16 and 17 1949 from the River Daya near Jagadala and Garasaguda respectively where it falls into the Chilka Lake (Orissa) The above places were visited in the course of the *Hilsa* investigations particularly with a view to finding out the spawning grounds of the Chilka *Hilsa* Postlarvae and young of *Hilsa* were also collected from this region and a detailed account of the bionomics of the fish in the Chilka Lake is in the course of preparation

S Jones
P M G Menon

Central Inland Fisheries Research Station,
Barrackpore (near Calcutta)
[illegible]8 1950

[1] Wilson, H. C *Govt. of Madras, Revenue Dept* G O 1219, (5th May), 1909
[2] Prashad, B, *Ann. Rept Dept, Fish Bengal, Bihar and Orissa* 1918 19, 4, 1919
[3] Hora, S L *Rec. Ind. Mus*, *40*, (ii), 147, 158 1938.
[4] Hora S L, and Nair K K, *Rec Ind Mus* *42* (i), 35 50, 1940
[5] Nair, K K, *Rec Ind Mus* *41* (iv), 409-418 1939
[6] Jones, S, and Menon, P M G, *Curr Sci*, *19*, 25, 1950

EFFECT OF PROTEOLYTIC INHIBITOR ON THE NUTRITIVE VALUE OF LEGUMINOUS PROTEINS LIKE SOYA VELVET AND NAVY BEANS

Rahman and De[1] have indicated that the low biological value of soyabean is due mostly to a proteolytic inhibitor as also to a toxic substance present in the raw soyabean It has also been shown that different varieties of soyabean contain varying amounts of this inhibitor which influences the biological and supplementary values of the soyabean

The soyabean Sub committee[2] in assessing the supplementary value of soyabean from the data then available observed that although soyabean was superior to other pulses in its net protein value fat minerals and vitamin contents it had practically no supplementary value to a poor rice diet Aykroyd and Krishanan[3] carried out experiments with rats feeding them with a poor rice diet supplemented with soyabean. The quantities of soyabean added to the diet corresponded to 3 and 1 5 ozs on the basis of human diet They found that the soyabean at the higher level had practically no effect on the growth rate of rats while the lower dosage produced a slightly better response as compared with the control They further observed that children receiving cooked soyabean as supplement to their diet lost weight

It was shown by Bowman[4] for the first time that soyabean and navy bean contained a fraction which inhibited the *in vitro* digestibility of casein by trypsin With the identification of a proteolytic inhibitor in soyabean by Ham *et al*[5], it was postulated that the proteolytic inhibitor present in raw soyabean was responsible for the low supplementary value Ham *et al*[5] have shown that partially purified solutions of the inhibitor produced adverse effects on rats fed on a balanced diet The adverse effect was more considerable specially when the diet was not balanced Navy bean and velvet bean also contain the proteolytic inhibitor and these in the raw state behave exactly like soyabean The studies on the biological value and supplementary effect of raw and acid extracted soyabean are detailed in this communication

Effect of acid extraction on the biological value of soya, velvet and navy beans The beans were ground to pass through a 40 mesh sieve The powdered material was extracted successively with about 5 times the volume of dilute acid (P^H 4 2), after each extraction the residues were separated by centrifuging the suspension of the acid and the bean powder. The extracted materials were then thoroughly washed with water till the P^H of the washed liquor was 5 6 to 5 8 The material was dried in current of hot air at 60°

The biological value of the raw and acid extracted bean were determined, employing the method developed by Mitchell[7] and the results obtained are presented in the following table

TABLE I

EFFECT OF ACID EXTRACTION ON THE BIOLOGICAL VALUE OF SOYA, VELVET AND NAVY BEANS

Biological value	Soyabean	Velvetbean	Navybean
Raw Bean	55	45	48
Acid Extracted Bean	*63*	*52*	*54*

The results recorded in the above table would show that acid extraction has produced significant increases in the biological value of all the beans The acid extraction has presumably removed the proteolytic inhibitor which was responsible for the low biological value of the raw beans

Effect of acid extraction on the supplementary effect of soyabean For these studies only the soyabean was taken up There were five groups of rats of nearly the same weight and age, each group having six rats They were all given a poor rice diet[8] The treatments are indicated in table II The rats were weighed every week and the experiment was stopped after a period of eight weeks The average gain in weight per rat per week is recorded in table II

TABLE II

EFFECT OF ACID EXTRACTION AND THE ACID EXTRACT OF SOYABEAN ON THE SUPPLEMENTARY EFFECT

No	Diet	Gain in wt per rat per week (in grams)
1	Poor rice diet	3 2
2	Same +10% extracted soyabean	4 6
3	Same + extract from 1 gm of soyabean	2 6
4.	Same + 10% soyaben	3 8
5.	Same + 10% extracted soyabean + extract from 1 gm of soyabean	3 6

The results presented in table II would indicate that (*a*) the acid treatment improves the supplymentary value of the bean, (*b*) the acid extract from one gram of the bean has an adverse effect on the growth of rats, and (*c*) the action of the raw soyabean and that of the extracted bean together with the acid extract from one gram, are nearly equal indicating that the presence of the inhibitor even in small amounts is sufficient to upset the beneficial influence brought about by acid extraction.

~~It would thus be clearly seen that the nutritive value~~ of soyabean is considerably enchanced by the removal of the proteolytic inhibitor Due consideration for the removal of this factor should be given to methods that are employed for processing the soyabean Further work on the above and related aspects are in progress

R RAJAGOPALAN
K SUBRAHMANYAN
S S DE.

Food Technology Laboratory,
Indian Institute of Science,
Bangalore 3- 10 3 1950

[1] Rahaman S A and De, S S 1950 (Under publication)
[2] Report on Soyabean by the Soyabean Sub committee Special Report I R F A No 13 Jan 1946
[3] Aykroyd, W R, and Krishnan, B G *Ind Jour Med Res* *24*, 707, 1937
[4] Bowman, D E *Proc Soc Expt Biol Medi*, *57*, 130,, 1944
[5] Ham, W E, and Sandsteet, R M *J Biol Chem*, *154*, 505, 1944
[6] Ham, W E, Sandsteet, R M, and Mussehl, F E *J Biol Chem* *161* 635, 1945
[7] Mitchell, H *M — 52, 873, 1924*
[8] Desikachar H S R, De S S, and Subrahmanyan, V *Ann Biochem* and *Exper Med*, *6*, 62, 1946

PERIODIC FADING OF RADIO SIGNALS FROM DÖPPLER EFFECT CONSIDERATION

In a previous communication[1] by one of us, the periodic fading observed when the frequency of the signal is very much less than the M U F value for either E or F layer was explained from the consideration of the Doppler effect due to the vertical movement of the ionospheric layers in the early morning or evening hours Formulae were also given for the frequency of periodic fading in the case of singly and doubly reflected waves from the same moving layer and *also in the case of singly reflected waves from the* two layers both moving with the same vertical velocity

The object of the present note is to point out and show that the Doppler effect interpretation is essentially the same as the view put forward by Banerjee and his colleagues[2] *According to the latter the* observed periodicity is due to the interference between the two waves singly and doubly reflected from the same layer or between the singly reflected waves from the two different layers when one or both possess a vertical movement, and is a consequence of the continuous change in the path difference of the two interfering waves which give rise to intensity maxima and minima, the periodicity depending upon the rate of movement of the ionosphere Both the views are equivalent representations of the same phenomenon It can be shown that the same expression is obtained for the periodicity of fading according to the two equivalent conceptions

In the adjoining diagram (Fig 1) SA represents the direction of the up going wave incident on the ionospheric layer which is at a height AO above the ground Let the path SA be denoted by s and the incident angle $\widehat{SAO}$ by θ If the layer has an upward velocity v, then in a finite interval of time Δt, it moves up through a distance AB which is v.Δt The direction of the incident wave suffering ionospheric reflection is

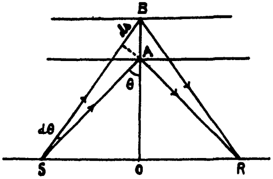


Fig 1

now SB and ∠SBO is now the angle of incidence which is denoted by $\theta\ \Delta\theta$ the ∠ASB being $\Delta\theta$ Denoting the height of the ionospheric layer by H we can write

$$\frac{\Delta\theta}{\Delta t} = \frac{v\,\Delta t\ \mathrm{Sin}\,(\theta\ \Delta\theta)}{\mathrm{H}/\mathrm{Cos}\,\theta}\ \frac{1}{\Delta t}$$

$$- \frac{v}{2\mathrm{H}}\ \{\, \mathrm{Sin}\,(2\theta - \Delta\theta) - \mathrm{Sin}\,\Delta\theta \,\}$$

For the limit $\Delta t \rightarrow 0$ $\Delta\theta \rightarrow 0$ we get

$$\frac{d\theta}{dt} = \frac{v}{2\mathrm{H}}\ \mathrm{Sin}\,2\,\theta = \frac{v}{\mathrm{H}}\ \mathrm{Sin}\,\theta\ \mathrm{Cos}\,\theta \qquad (1)$$

The path difference ds for an infinitesimal time dt is given by

$$ds^2 = v^2\ dt^2 - \left(\frac{\mathrm{H}}{\mathrm{Cos}\,\theta}\right)^2 d\theta^2$$

$$\text{or} \left(\frac{ds}{dt}\right)^2 = v^2 - \left(\frac{\mathrm{H}}{\mathrm{Cos}\,\theta}\right)^2 \left(\frac{d\theta}{dt}\right)^2 \qquad (2)$$

From (1) and (2) we have

$$\frac{ds}{dt} = v\ \mathrm{Cos}\,\theta \qquad (3)$$

Further $s = n\ \lambda$ where n is the number of wavelengths covered by the path s and λ the wavelength propagated Since λ is constant

$$\frac{ds}{dt} = \lambda\ \frac{dn}{dt} = \frac{c}{f}\ \frac{dn}{dt} \qquad (4)$$

where f is the frequency corresponding to the wavelength Thus from (3) and (4) we get

$$\frac{dn}{dt} = \frac{f}{c}\ v\ \mathrm{Cos}\,\theta$$

At the receiving point on the ground where the down-coming wave is received, the path-difference is doubled and we can write

$$\frac{dn}{dt} = \frac{f}{c}\ 2v\ \mathrm{Cos}\,\theta \qquad (5)$$

The right hand side of the above relation is clearly the expression for the Döppler change of frequency on reflection from a mirror moving with velocity v, *viz*,

$$df = f\ 2v\ \mathrm{Cos}\,\theta$$

The formulae given in the previous note already referred to for the periodicity as expected from the continuous change in the path due to the vertical drift of the ionosphere are only approximate The approximation makes them appear different from the Döppler effect formulae

S R Khastgir
P M. Das

Physics Dept,
Banaras Hindu University,
15 3 1950

---

[1] Khastgir S R Science and Culture *15* 116 1949

[2] Banerjee S S & Mukherjee G C *Phil Mag 39* 697 1948
Banerjee, S S & Singh R N Science and Culture, *14* 293 1949
Banerjee, S S & Singh R N *Ind. Jour Physics 22* 413 1948

FOSSIL FLOWER FROM THE MOHGAON KALAN BEDS OF CHHINDWARA C P INDIA

The Deccan Intertrappean series is exposed near a small village Mohgaon Kalan in the Chhindwara District of the Central Provinces (now Madhya Pradesh) India The age of these beds is most probably Eocene

In one of the cherts of these beds a beautiful petrified flower is found revealed in a longitudinal section (Fig No 1) The preservation being good, the structure of the flower is clearly seen even microscopically

Fig. 1 *Type specimen* The piece of chert exhibiting flower in longitudinal section, X ½ f—Fracture.

The most remarkable feature is that the flower is complete with all its whorls being present Even the bracts at the base of the long pedicel are clearly seen (Fig No 2, br and p) In the observation so far, it seems that this flower though resembles in its form, and general view with the *Sahnianthus* described by Shukla[1] differs in size, the details of structure, and the outstanding feature of the presence of two bracts which is nowhere seen and mentioned in *Sahnianthus* so far

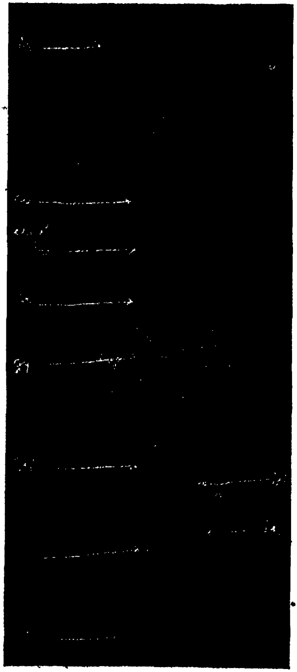


Fig. 2.

Type specimen. A magnified photo of the flower br—bract; bri—bracteole; p—pedicel; Ca—Calyx; Co—Corolla; Gy—Gynaecium; Ep. St.—Epipetalous Stamen; X 10.

It is of great interest that all the floral parts are seen all together in this single specimen alone

Unfortunately this specimen got a fracture while handling (Photo No 1, tr), but fortunately enough, this does not conceal the vividity of the floral parts Both the photographs are taken of the specimen as such *in situ* without further grinding Photo No. 2 is taken first in parts, in the same magnification and then photographed in one focus after pasting the different pieces together This process had to be adopted far want of a good equipment at hand Further investigation is still going on, after which a detailed account will be published

(Mrs) S D Chitaley

College of Science,
Nagpur (Madhya Pradesh), 17 3 1950

---

[1] Shukla, V B —*Proc Nat Acad Sc Ind*, *14*, 1 39, 1944.

GROUNDNUT HUSK AS CATTLE FEED

The annual produce of groundnuts in India is about 34 lac tons The undecorticated groundnuts consist approximately of one third husk and two third nuts The nuts are expressed to obtain oil for edible purposes and the groundnut cake, which is produced as a by product serves as a cattle feed The possibility of using groundnut husk (g n h)— which accumulates in huge quantities at the factory head—as a cattle fodder, specially during scarcity periods, has been investigated As a result of the earlier investigations in these laboratories it has been found that substances like mango seed kernel[1], jaman seed[3], tamarind seed[4] and panevar seed[2] etc hitherto considered as wastes, constitute, on processing, valuable sources of livestock feeds

Chemical composition of g n h The percentage composition of g n h is total ash, 4 25 , crude protein, 8 25 , ether extract, 0 62 , crude fibre, 57 44 , nitrogen free extract (n f e), 29 44 , CaO, 0 31 and P_2O_5, 0 28. The crude protein and crude fibre contents of g.n h are high as compared with common roughages like wheat *bhoosa* and rice straw On the basis of crude fibre content, gram stalks are the nearest approach to g n h The CaO and P_2O_5 contents in g n h are normal for a roughage

Exploratory feeding experiments In an attempt to find out whether g n.h could constitute the entire roughage moiety, it was observed that the *Kumauni* bullocks of 300-400 ℔ live weight could consume only about 4 ℔ of g.n.h , which along with the concentrate provided only 1 1 3℔ of dry matter per 100℔ body weight. Since the amount of dry matter consumption was considered less, a supplement of wheat *bhoosa* to the extent of two pounds was given. In addition to the roughage, the animals received a pound of rape cake and an ounce of salt The feeding was continued for a period of 3 months during which no untoward symptoms were observed On the other hand the adult bullocks which ordinarily maintained weights on the Institute schedule ration, gained on an average 20 per cent of their original live weight At the end of this period a detailed blood study was made and the various blood constituents were found to lie within the normal range of variation.

One more set of three *Kumauni* bullocks was kept on the above ration for a month The animals in this set also did not show any adverse effect of this feed combination.

It was observed in feeding g n h , that the animals could be got used to it by incorporating small quantities in the beginning in the commonly fed roughage. The animals started relishing it after about a week. It was found that g n h mixed with equal proportion of wheat *bhoosa* was quite palatable to cows, calves, bullocks and buffaloes

Digestibility and nutritive value of g n h In order to determine the nutritive value of g n h , six *kumauni* bullocks of 300 400 lb live weight were fed for a period of about six weeks on the following ration roughage (g n h and wheat *bhoosa* in the ratio of 1 1) 5-8 lb , cake one pound and common salt, one ounce

During the latter part of the feeding period a ten-day metabolic trial was conducted The average digestion coefficients, as obtained by the process of elimination, for crude protein, crude fibre and n.f e. in g.n.h were 47 14 and 18 respectively The digestible nutrients per 100 lb of husk were 3 88 lb digestible crude protein, 8 04 lb digestible crude fibre, 5 30 lb digestible n.f e and 17 22 lb total digestible nutrients The animals almost maintained N CaO and P_2O_5 balances Their body weights also did not record any variations, nor did the different constituents of blood.

Alkali treatment of g n h In the previous experiment it was found that the digestibility of crude fibre and n.f.e in g.n h was low This was attributed to the complex deposition of lignin in the cellulose structure. It has been found in this laboratory[5] that this complex in case of paddy straw is loosened by alkali treatment A similar attempt was made to try this procedure in the case of g n.h

It has been found that when the g n h is steeped in 1% caustic soda solution for 24 hours and then washed twice in water, the chemical composition varies from the untreated g n h in so far as the crude protein and ether extract contents are lowered The CaO content recorded a slight increase whereas the P_2O_5 content decreased.

A similar metabolic trial with another set of six animals was conducted under the same conditions as with the untreated husk The average digestibility of crude protein, crude fibre and n.f.e. were 10, 20 and 16 respectively The daily retentions of N and P_2O_5 were considerably depressed though that of CaO was not much affected. The other important changes brought about by alkali treatment were the reduction in the digestibility of crude protein by 80%, increase in the digestibility of crude fibre by 57% and a negative digestibility coefficient in the case of n.f e Also, the animals recorded a fall in their weights during the course of this feeding trial extending over a period of six weeks. In view of the above it is considered that the alkali treatment of g.n.h., which in processing involves additional expenditure, is not desirable.

It may be concluded that the g.n.h., most of which is not economically utilised at present, can be fed to dry and adult stock up to 50 precent of the roughage moiety, though from the point of view of large scale feeding over long periods, it should constitute one fourth to one third of the roughage only. Under normal conditions, however, it should not be fed to high producing and very young animals.

The detailed article will be published in the *Indian Journal of Veterinary Science and Animal Husbandry*

N. D. Kehar
S. S Negi

Animal Nutrition Section,
Indian Verterinary Research Institute,
Izatnagar, 3 4-1950.

---

[1] Kehar, N D and Chanda, R *Ind. J Vet. Sci & Anim. Husb*, *15* 280, 1945

[2] Kehar, N D and Murty, V N *J Sci. & Indus. Res.* 9B 77, 1950

[3] Kehar, N D and Sahai, B. *Science and Culture*, *14* 534, 1949.

[4] Kehar, N D and Sahai K *Ind. J Vet. Sci. & Anim. Husb.* *19*, 37,1949

[5] Sen, K. C , Ray, S C and Talapatra, S. K. *Ind. J. Vet. Sci. & Anim Husb* *13*, 263, 1943.

RAPID DETERMINATION OF THORIUM IN MONAZITE SAND

Exact and rapid methods for the quantitative determinations of thorium are of interest because of the growing importance of the element in the production of catalysts and alloys and in the investigation of nuclear phenomena. For rapid determination, recourse must be taken to methods working in strongly acid solutions, since in such cases, prior removal of phosphoric acid is unnecessary.Only few methods are available— Iodate method of Meyer and Speter[1] in strong nitric acid, pyrophosphate method of Carney and Campbell[2] in 0 3—0.4N HCl and hypophosphate method of Rosenheim[3] in strong hydrochloric acid. All of these methods are costly, long drawn and tedious, since in all cases, the process should be repeated to make the precipitated thorium compound pure.

Search for a rapid determination of thorium in presence of rare earths and phosphoric acid has been found necessary. Thermometric titration has been used by numerous workers in recent days for quantitative volumetric analyses This method has been successfully employed for the determination of thorium Thorium has been determined thermometrically by titration with a solution of sodium pyrophosphate in acid solution The method has been found applicable to the determination of thorium directly in the solution obtained by the decomposition of monazite sand after adjusting the necessary acid concentration The optimum acid concentration has been found to be in the neighbourhood of 1 2N The method resembles very much the method of Carney and Campbell[2] the required acidity being somewhat higher; it gives results quite comparable with those obtained by the same and other chemical methods and at the same time is very quick and easy Results are shown in the above table and the diagram (Fig. 1) Fifty gms of sand are decomposed with concentrated sulphuric acid and diluted to one litre Aliquot parts have been taken from this stock solution for thorium determinations

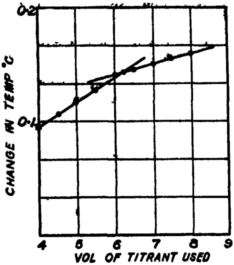


Fig 1

Table

No	Volm of soln taken	Volm of Na_4P_2O soln reqd		% of ThO_2		
		Theor	Expt	Thermometric method	Carney and Campbell s method	H_2O_2 method
1	50 c c	6 2 c c	6 2 c c	7 2	7 2	7 16
2.	100 c.c	12 4 c.c	12 3 c c	7 1		

Details of the work will be published elsewhere

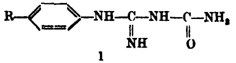
N K Dutt

Inorganic Chemistry Laboratory,
University College of Science and Technology
92, Upper Circular Road,
Calcutta 3-4-1950

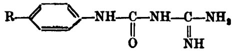
Meyer and Speter, *Chem. Ztg* 34, 306 1910.
Carney and Campbell, *J A C S* 36 1134, 1914.
Rosenheim, *Chem. Ztg* 36, 821, 1912.

TRANSFORMATION OF BIGUANIDE INTO DICYANDIAMIDINE

In a previous publication in this journal[1] it was observed that N^1 p sulphonamido and N^1 p substituted sulphonamido phenyl biguanides in dilute mineral acids changed more or less rapidly with loss of ammonia into corresponding dicyandiamidine salts in an almost quantitative yield The product on analysis gave values agreeing with one or the other of the following constitutions I and II (with $R - SO_2NH_2$)



1



II

Neither a copper nor a nickel salt could however be isolated from the changed product This gave rise to some suspicion regarding the validity of either of the above constitutions

In order to arrive at a definite decision about the constitution of the changed product a direct synthesis of the dicyandiamidine of the constitution (I) and (II) was therefore considered desirable Various attempts to synthesise the substituted dicyandiamidine of structure similar to (II) were first made Some of the methods *viz* fusion of guanidine carbonate with substituted urea or urethane though gave positive results with phenyl urea or phenyl urethane failed however with their sulphonamide derivatives But it was observed that phenyl or p—chlorophenyl dicyandiamidine of structure II (with $R=H$ or Cl) thus synthesised gave no characteristic copper or nickel compounds contrary to usual expectation This seemed to suggest that the changed product might as well be a substituted dicyandiamidine of structure II (with $R=SO_2NH_2$) This was finally confirmed by the actual synthesis of the compound as follows The phenyl dicyandiamidine of structure II (with $R-H$) was treated with chlorosulphonic acid This gave the corresponding acid chloride from which by subsequent reaction with ammonia N^1 p sulphonamido phenyl dicyandiamidine sulphate (structure II with ($R{=}SO_2NH_2$) was obtained, having properties indentical with that of the changed product from N^1 p sulphonamido phenyl biguanide sulphate

Substituted dicyandiamidine of structure I (with R=H or Cl) has also been synthesised from the corresponding dicyandiamide, though an attempt to prepare the corresponding p sulphonamido phenyl dicyandiamidine led to no fruitful result It should, however be noted that substituted dicyandiamidine of structure I (with R=H or Cl) gave as usual the characterestic coloured complexes with copper and nickel, unlike that of its isomer with structure II This is a fact of particular significance in the complex chemical and analytical reactions of dicyandiamidine

From all these considerations there is no room for doubt now that the product resulting from a hydrolytic change of N-p sulphonamido phenyl biguanide in dilute acid solution is a dicyandiamidine of the structure II which gives no reaction with nickel or copper salts

Such rapid hydrolysis as of N^1 p sulphonamido phenyl biguanide has been observed also in the case of its derivatives with substitutions in NH_2 of the SO_2NH_2 group But the change is more or less completely inhibited by a phenyl substitution in the N^5 position of the biguanide

I desire to express here my grateful thanks to Professor P Rây for his guidance and kind interest in the work

NAKULESWAR KUNDU

Palit Professor's Laboratory,
Dept of Pure Chemistry,
University College of Science,
Calcutta 1 4 1950

---

[1] SCIENCE AND CULTURE, *15*, 241, 1949

BOOK REVIEWS

Vegetable Gums and Resins—By F N Howes, Published by the Chronica Botanica Company, Waltham, Massachusetts, U S A 1949 Pp 188 Price $5 00

The vegetable gums and resins are important groups of plant products which are used in modern industry in manufacturing processes of various kinds The world trade in natural resins has been estimated to be annually about 75 000 tons

The number of species of plants that yield gums or resins runs to many thousands In this book however, only those that are of commercial or otherwise of interest have been mentioned Those which have become of commercial importance in recent years, *e g* carob seed or locust gum, sterculia gum, tragacanth substitutes, certain acacias etc have also been dealt with in detail

The book has been divided into two parts, Gums and Resins Part I consists of six chapters which deal with subjects such as the nature and uses of gums, gum arabic and other acacia gums, gum tragacanth and similar gums, some well known and much used Asiatic gums etc and Part II runs to eleven chapters dealing with practical aspects of resin, *e g* properties and uses of resins, copals rosin and colophong, kauri resin lac resin and shellac, natural lacquers, medicinal resins etc The economic aspect has been more emphasised in this book and the botany of the gum and resin bearing plants

Recent information are lacking for the chemistry of gums and resins

The book is illustrated, and references to the old literature are adequate This can well be passed for an authoritative treatise.

R C.

Streamline Flow—By H F P Purday Constable & Co Ltd 10 Orange Street London, W C 2 Cloth 22×14 cm pp viii+185, and dust proof cover, 1949, Price 18 Sh

A vast literature has accumulated on the subject of turbulent and non turbulent flow and another publication on the subject would therefore give the impression that it would be more or less similar to others A detailed perusal of this text however reveals the fact that it is different from most of the previously published books on the subject in that it bridges the apparently wide gap between the elementary and advanced work in this field and presents in a compact form the three closely related parts of physics *viz* non turbulent flow, flow of heat by conduction and heat transfer between solids and fluids in states of non turbulent flow The mathematical developments of the theory are presented by the use of gamma and conjugate functions, solutions of differential equations in series, relaxation methods, and elliptic integrals The engineering applications of streamline flow are described and useful analogies such as torsion of prisms, deflection of membranes, and vibration of strings presented to give an idea of the potentialities of mathematical physics The text is mainly free from misprints and errors The reviewer however found that pages 65 to 72 and 89 to 96 were duplicated, while pages 73 to 88 were missing

To a student and research worker grounded in the elements of calculus this text will prove to be of good use for studying the various aspects of non turbulent flow

S K G.

Water in the Physiology of Plants—By A S Crafts H B Currier and C R Stocking Publishers Waltham Mass the Chronica Botanica Co Calcutta MacMillan & Co Ltd 240 pages and 56 illustrations Price $ 6 00

It is needless to emphasise the importance of the subject matter of this book because water is not only indispensable for plants but a favourable water balance in essential to their growth and development In this context therefore the book is welcome as it explains the role water plays in the physiology of plants

This book was probably written during or immediately after the last war but an attempt has been made in the preface to make it up to date by the inclusion there of a summary of the more important contributions that appeared later The discussion states with a considerations of the physical nature of water the properties of solutions Osmosis osmotic presence and mechanism of osmosis have been discussed in chapters four and five and intercellular distribution of water osmotic quantities of cells and cell water relations in the successive three chapters Last two chapters have been devoted to uptake and movement and loss and retention of water Each chapter is again summarised separately The book is therefore self contained within the perimeter of its title

The present volume however is intended primarily to be a reference book As such it had to be reasonably complete and the authors had little freedom in the choice of material Still it must be said to their credit that the basis and the principles of the subject have not been lost sight of in the midst of details With brief but critical exposition of different aspects of the subject and with an extensive bibliography the book is amazingly rich containing much more material than its volume would indicate

The book is well bound and neatly printed

J K C

Advanced Chemical Calculation—By Sylvanus J Smith M A Macmillan and Company Limited London 1950 pp viii+454 Price 17/ Sh net

The present treatise is a valuable addition to the series of books published on this subject It deals with such varied subjects as Equivalent and atomic weight Molecular theory including kinetic theory of gases Vapour pressures of liquid mixtures and solutions Solubilities partition law and congruent melting points Law of mass action including chemical kinetics Abnormalities in gases and in solutions Thermochemistry Volumetric analysis Simple calculations in organic chemistry Maximum work of physical change from thermodynamical standpoint Application of the second law of thermodynamics to solution Some important thermodynamical equations Concentration cells including the use of Gibbs-Helmholtz equation, Standard electrode potential including electrodeposition of metals and hydrogen overvoltage Third law of thermodynamics The book is well planned as is evident from the arrangement of chapters as also from the development of the subject in each chapter Theoretical treatment of the principles involved in the calculation of problems as also the inclusion of numerous suggestive questions at the end of each chapter are important features of the book Inclusion of one chapter or two on gravimetric analysis would have added to the usefulness of the book The term advanced' in the title of the book does not appear to be quite appropriate as the major portion of the book deals with rather simple chemical calculations and even the advanced problems dealt with are only up to the Honours Degree standard The author himself seems to be conscious of the fact (preface page v) and defines the objective of the present volume as to furnish practice in numerical problems up to and including questions of Honours Degree standard On the whole the publication of the advanced chemical calculations is welcome and it will fulfil its objective The book can be recommended to the students preparing for the Honours Degree Examination in chemistry

B C

Insight and Outlook—By Arthur Koestler MacMillan & Co Ltd London 1949 Price 25/ Sh net

Whatever views may be held by different reviewers about the concepts presented in the book there will be no disagreement we are sure about the splendidly lucid style of the author The book is extremely pleasant to read and one hardly realises that he has covered so many pages when he first stops reading

The author has introduced some new concepts the most original of which is the concept of bisociation With the help of these concepts he has attempted to formulate a general theory which will explain such diverse matters as the comic and the tragic the discovery of scientific laws and the appreciation and creation of art

His plan is a bold one and he has certainly given us a new point of view While freely admitting that the concept of bisociation is a fruitful one further researches would be needed to establish it definitely We shall eagerly await the appearance of the second volume in which the author proposes to present a synthesis of the many ideas and currents of thought expounded in the present volume

S C M

The Development of Education in the Twentieth Century—By Adolph E Meyer, Ph D Prentice Hall, Inc, 70, Fifth Avenue, New York 11, N Y, U S A Cloth 5½"×8½" pp xvii+609, 1949, Price $ 6 45

The book under review which is one of the Prentice Hall Education Series comes from the pen of a Professor of Education, New York University It contains a compact and lucid account of the development of education in Europe and United States in this century with special emphasis on the philosophies of American system The author has brought to light how the findings of naturalism, experimentalism psychology and psychoanalysis, sociology anthropology and general advances in science have rendered educational activity far greater than witnessed in any previous era Side by side he also reveals the fact that inspite of the general growth and progressive transformation, education today, with a few salient exceptions remains the servant of an old and obsolescent order purblind to some of the most fundamental facts of society, economics and politics

The subject matter is essentially divided into three themes The first deals with the aspect of modernising education Herein the work of the 18th century educationists like Rousseau (1712 1778) of France Basedow (1724 1790), Pestalozzi (1746 1827), Herbart (1776 1841) & Froebel (1782 1852) of Germany and Parker (1837 1902) of the United States is considered and their impact on twentieth century education recorded The author also surveys the work of John Dewey, his theories and philosophy and the scope of education after his time. Education outside the new world is discussed with reference to the work of such pioneers like Maria Montessori of Italy, Jan Ligthart of Holland, Decroby of Belgium, Roger Cousinet of France, Berthold Otto of the pre-Nazi school of Germany, Ferrière of Switzerland, Bertrand Russel of England, Shatsky of Russia and Franz Cizek of Vienna

The development of National Systems of education is treated as the second theme Progress in England, France, Germany, Italy, Russia and the United States is surveyed in a very lucid and authoritative manner capable of being grasped by any one interested in the subject As the author states in his preface the developments in education in China, Japan, India and Australia are omitted from this volume to keep down the length of the text They are however proposed to be dealt with in a subsequent volume The third and the last theme deals with miscellaneous features such as the scientific, psychological and the Platoon school movement in education, the problems of youth, of educating exceptional children and modernising colleges, workers' and adult education and international education including the work of Unesco

The author has appended an excellent bibliography of over 150 items and veritably produced a book which forms an authoritative guide to a comparative study of general education

S K G

VOL. 15 JUNE 1950 No 12

AGRICULTURAL EDUCATION AND RESEARCH IN INDIA 453
Is Communal Conflict or War Instinctive?—*K C Mukherji* 462
Forest Ecology and Evaporation Measurements in India—*G S Puri* 465
Indian Weather and Locust Immigration in India—*R V Badami* 467
Wild Mangoes of India—*Sunil Kumar Mukherjee* 469
Education in Germany with Special Reference to the System of Chemical Education—*Haragopal Biswas* 471
Total Synthesis of Estrone and its Isomers—*D K Banerjee* 474
Atoomenergie and Atombombe 475
NOTES AND NEWS 477
LETTERS TO THE EDITOR
Calcium Gluconate from Cane Sugar —*S Balsundaram R K Hirani* and *V Subrahmanyan* 483
On the Bionomics of the Carp *Thynnichthys Sandkhol* (Sykes)—*P I Chacko* and *S V Ganapati* 484
Theory of the Corona Disc Colours—*Y G Naik* 485
Energy of Homopolar Bonds—*S K Kulkarni Jatkar* and (*Miss*) *S B Kulkarni* 486
Effect of Refining and Deodorization of Coconut Oil on Calcium Utilization—*H N De* and *J N Karkun* 486
Development of the Female Gametophyte of *Oryza Coarctata* Roxb—*A K Paul* and *R M Dutta* 487
New Reagents for the Characterization and Purification of S Guaiazulene—*K B Dutt Sukh Deb* and *P C Guha* 488
Need for Investigation on Synthetic Motor and Aviation Fuel for India—*J N Rakshit* 488
Search for New Antibiotic Producing Fungi for Controlling Pathogenic Organisms—*S K Mukherjee S Sen* and *P N Nandi* 489
Sunspot Activity and Cosmic Ray Disturbances —*I L S Chakraborty* and *P K Sen Chowdhury* 490
Systematic Sampling III—*A C Das* 491
BOOK REVIEWS 492

The annual subscription to the journal is Rs. 10/ (inland) £ 1 or $4 00 (Foreign) Ordinary Membership fee for the Association is Rs 15/ (£ 1 10s or $ 5 00) per year which covers the subscription of the journal A person or a Corporation paying Rs. 150/ (£ 12 or $ 48.00) shall be eligible for a Life Membership of the Association and will be entitled to a copy of the journal every month.

The Indian Science News Association and the Editors of 'SCIENCE AND CULTURE" assume no responsibility for statements and opinions advanced by contributors to this Journal.

All MANUSCRIPTS should be legible and typewritten. The Editors reserve to themselves the right to accept or reject the whole or portions of the matter sent for publication. The rejected contributions are not returned to authors, if postage is not prepaid

Remittances for membership dues, subscription and advertisement costs should be addressed to the TREASURER, INDIAN SCIENCE NEWS ASSOCIATION, at 92, Upper Circular Road, Calcutta, 9

Editorial communications are to be addressed to the Editor and other communications to the Secretary, Indian Science News Association, both at 92,Upper Circular Road, Calcutta, 9.

SCIENCE AND CULTURE

A Monthly Journal of Natural and Cultural Sciences

Published by the
INDIAN SCIENCE
NEWS ASSOCIATION

Editors
D M Bose
S K Mitra A C Ukil
P Ray S N Sen

Associate Editors
A K Ghosh
R Chatterjee B Mukherjee

Collaborators
S P Agharkar Atmaram
G C Mitra K G Bagchi
A C Banerjee K Banerjee
S K Banerjee K P Basu
D N Wadia K V Giri
H P Bhaumik K Biswas
N N Chatterjee N K Bose
D Chakravarti N R Dhar
S C Chatterjee J C Saha
S P Chatterjee A C Joshi
N N Dasgupta S L Hora
G J Fowler N R Sen
S S Bhatnagar H P Maity
P C Mahanti B Mukerji
S. C Mitra S. R Palit
J N Mukherjee N C Saha
Kamalesh Ray B B Sarkar
S K Ghaswala J M Sen
V Subrahmanyan S N Sen
B. C Kundu S C Sirkar
S S Sokhey J N Bhar
Maneck B Pithawalla
K. P Chattopadhyay
S P Ray Chaudhury
H K. Mookherjee
Surendra Nath Sen

Editorial & Publication Offices
92 Upper Circular Road
Calcutta 9.

Advertising Office
92 Upper Circular Road
Calcutta 9

LET US HELP YOU

IN OBTAINING

ALL YOUR LABORATORY EQUIPMENT

WE SPECIALISE IN

SCIENTIFIC APPARATUS

OF ALL KINDS

ALSO

ACIDS, SOLVENTS & OTHER CHEMICALS OF REAGENT QUALITY

OUR PATRONS INCLUDE
REPUTED TECHNICIANS IN
VARIOUS INSTITUTIONS AND
INDUSTRIAL CONCERNS
THROUGHOUT THE COUNTRY

ENQUIRIES RESPECTFULLY SOLICITED

Bengal Chemical

& PHARMACEUTICAL WORKS LTD.

94, CHITTARANJAN AVENUE, CALCUTTA 12.

SCIENCE AND CULTURE

A Monthly Journal of Natural and Cultural Sciences

Vol. 15 JUNE 1950 No. 12

AGRICULTURAL EDUCATION AND RESEARCH IN INDIA

III

IN a previous article[1] we gave an account of the progress which had been made during the first half of the century towards the introduction of agricultural research education and development in this country at the same time the movements for rural cooperation rural reconstruction and basic education were also described.

We shall now try to assess the achievements of these movements and to indicate the directions along which future development should proceed.

Research and Development.—Some notable progress had been made through the efforts of the Institutes for Agricultural and Animal Husbandry Research in some of the provincial Agricultural Experiment Stations and also in some under Central Commodity Committees.

The opinion has however been expressed that 'while under grants-in aid received from the I C A R a good deal of research work has been carried out the improvements effected have not been taken up by the cultivators *i e*, there has been a lack of coordination between research development and extension work. The implication has been that the latter two are the responsibilities of the provincial agricultural departments and they have not pulled their weight in the team work. In our view which shall be discussed later a better machinery has to be devised for this purpose which involves certain redistribution of subjects now placed in the Union, State and Concurrent lists in the Indian Constitution.

Taken all in all, the progress achieved so far has not been commensurate with the vastness of the problems involved and with the variety of subjects relating to agriculture on which government action is necessary. We have probably in Institutes under the Ministry of Agriculture and in the Commodity Research Stations and Technical Laboratories small sections dealing with the breeding of disease resistant food cash and other crops for Agricultural and Soil Engineering Agricultural Chemistry for Dairy Industry and Animal Husbandry for Entomology and Plant Quarantine but most of them are in their early stages of development. There should be a large number of regional laboratories for plant science and animal husbandry and for their processing and industrial utilization soil investigation laboratories bureaus for the classification and study of microorganisms and pests so far as they affect agricultural and animal husbandry industries. The Centre should also take an active part in starting and financing of provincial agricultural experiment stations and in providing machinery for the coordination of the work of the central and provincial agencies. Agricultural education in the higher stages the training of teachers for agricultural high schools in the provinces as well as extension work should also be the responsibility of the Centre.

Financing of Agricultural Research—We have collected in the following table some data obtained from different sources on the relative areas under cultivation of the different food and cash crops and the amount spent for research processing and marketing of these commodities.

We find that a disproportionate amount of money is spent on research on cash crops which form only about 14% of the area under cultivation while research on food grains and pulses and other crops which form about 81% of the area under cultivation are comparatively neglected. This was probably a result of the British rule when the foreign traders and industrialists were primarily interested in the raising and technological processing of cash crops. This arbitrary division of food and cash crops should be done away with and all commodity research stations should be placed on the same footing as in the U S A.

Problem of Agricultural Education—From the beginning the education was top heavy. There was a need for the starting of agricultural colleges for the training, at least of recruits to Government agricultural services, but the openings were relatively limited and the colleges did not attract sufficient number of the sons of land owning class s On the other hand there is not a large class of yeoman farmers whose sons could have benefitted by education in agricultural colleges and particularly in agricultural high schools The latter have been utilized for the training of agricultural over seers it is doubtful whether the training given was sufficiently thorough in theory and in farm practical work The majority of the sons of cultivators burdened with uneconomical holdings did not receive any primary education much less education of a suitable kind Rural education must be reorganized from the bottom upwards from basic primary and agricultural high schools to colleges situated in the midst of agricultural areas

---

[1] *Science and Culture*, *15*, 467, 1950

TABLE

Authority	*Source of Income*	*Amount of grant*	*Percentage of cultivated areas*
I C A R	Cess on certain agricultural commodities	Rs 11 00 lakhs	
I C A R	Ministry of Agriculture I C A R	Rs 11 70 Rs 2 63	80 9% (food grain & pulses)
Commodity Research Institutes for Rice Potato etc	Ministry of Agriculture	not known	
Under Central Commodity Committees	Whole or part of cess levied	Cotton (Rs 18 lakhs) Lac (Rs 10) Jute (Rs 7) Sugarcane (Rs 11)	8 3% approximately
		Oilseeds Tobacco and Coconut	6% not known

Cotton Lac Jute and Sugarcane Central Committees have their Technological Research Laboratories at Matunga Namkum Calcutta and Kanpur respectively

The data are approximate and taken from I C A R Handbook (1948) I A R I Report (1944 45) and Famine Commission Report (1944)

The possibility of introduction of such education depends on some measure of rural prosperity which will act as an incentive to the people for further cooperative efforts to improve their economic and social status The Gandhian ideal of self sufficient village communities supported by the present type of agricultural industry and handicrafts will not be able to meet the requirements of an overpopulated rural communty facing competition of industrialized towns The Congress movement of the 1930 s attracted a large number of idealist worker But since Congress has come to power from 1947, the movement appears to have lost much of its idealism and driving force

Rural Indebtedness and its Removal—The high agricultural prices prevailing since the commencement of the last war and which is still continuing, have to a certain extent removed one of the permanent handicaps to the development of healthy rural communities *viz* rural indebtedness, based upon low prices of agricultural commodities The pre war exploitation of the rural population by the industrial and commercial communities has for the present been reversed, resulting in a general rise in the cost of living This black mailing of the town by the country will not be an unmixed evil if it leads at least in some of the more flourishing of the rural areas to the abolition of indebtedness amongst the cultivators and to instal in the latter a desire to introduce better amenities of life in the villages The State can help this movement by providing amongst other facilities, cheap electric power to the rural communities This will benefit not only agricultural production but also help in the introduction of power driven rural industries The Famine Commission (1944) reported that between 1942 and 1945, there was a substantial reduction of rural indebtedness in all the provinces especially amongst cultivators with large holdings and to a considerable degree amongst those with medium holdings On the other hand it appears probable that the small holders as a class have not benefitted materially

The beginnings of rural prosperity thus initiated cannot be maintained unless some scheme for regulation of prices of agricultural commodities be adopted which will ensure a fair minimum price for the cultivators and a fair maximum price for the consumers and undue fluctuations of prices be prevented For reasons stated in their Report the Famine Commission recommended that the simplest remedy would be to maintain the prices of the two principal cereals rice and wheat within predetermined limits even if it should be found that the prices of the other commodities cannot be regulated

Rural Rehabilitation—Future development of rural areas will depend on two sets of factors *viz* (*i*) the facilities which the Government can provide and (*ii*) how the people can organize themselves so as to obtain the maximum benefit for themselves out of the facilities so offered

(*i*) The Government can promulgate laws regarding the size of holdings and their assessment, minimum prices for agricultural commodities can supply rural areas with cheap electricity irrigation facilities suitable education and health services provide the rural communities with improved disease resistant seeds manure and fertilizers make provision for large scale supply of credit and of technical assistance and supervision

(*ii*) Government assistance can only be effective when the community is organized for cooperative efforts in all spheres of their lives If they can develop an enlightened cooperative spirit, in which their rational self interest will be safeguarded, and know how to demand and utilize Government assistance, then only will prosperous self governing rural communities develop

After discussing the respective merits of 'Collective farming, Joint farming and Cooperative farming', the Famine Commission came to the conclusion that the future development of agriculture in the case of small and medium farmers depend in considerable measure on the organization of these classes into multipurpose village cooperative societies They make recommendations as to how these societies should be federated into unions and what procedure should be adopted for their effective working Large landholders are to be encouraged to organize themselves into agricultural associations and the farm workers also be encouraged to organize themselves

In the concluding chapter of their Report they remark

> that the food problems with which we have been primarily concerned merges into broad problems of agricultural and economic developments and these in turn are linked up with fundamental social questions Poverty and hunger have been too often accepted as part of the nature of things and much of the countryside may almost be described as a rural slum where hopelessness engendered by slum conditions prevail Such an attitude of mind on the part either of rulers or of ruled is incompatible with progress Without vision and faith in the *future little can be achieved*

This brings us to the consideration of proposals which the University Commission has made for providing an educational programme suited to bring into being the new state of rural society As an illustration of how such things have been done in other countries they describe in detail the part played by the land grant colleges of the U S A with their associated Agricultural Experiment Stations and Extension Services all run on a cooperative basis between the Agricultural Department of the Federal and State Governments The Commission s recommendations on agricultural education and rural universities are very much influenced by the U S A examples

We do not believe that the Indian problem can be solved by an unintelligent imitation of U S A practices The U S A is a comparatively thinly populated country which has made it possible to have large farms the shortage of labour has encouraged mechanization of farm work During recent years horse drawn agricultural machines have been replaced by power driven tractors and other appliances Such large scale farming has led to certain undesirable agricultural practices under which the soil has in many regions deteriorated badly Efforts are now being made to stop this soil deterioration While the yield *per capita* of agricultural worker is very high the yield per acre is moderate compared to what is obtained in many of the western European countries In this country primarily of small holdings and superfluity of manual compared to available mechanical power the problem requires a different approach Nevertheless due to the similarity in political structure in the two countries *viz* , Federal union of States enjoying a great deal of autonomy the machinery evolved in the U S A for coordinating the activities of the Federal and State Departments of Agriculture are worth studying and adoption, with necessary modifications, in our country

We shall devote the rest of the review in discussing

A American agricultural administration and education programme

B Reform in Indian agricultural education and administration and

C Rural Secondary and University Education in India

A *American Agricultural Administration*—It is interesting to note that during 1862 when under the Morril Act grants of federal lands were made to the different States and Territories of the U S A for the endowment support and maintenance of at least one college in each State which were enjoined to teach amongst other things such branches of learning as are related to agriculture and to mechanical arts in order to promote liberal and practical education of the industrial classes in the several pursuits and professions of life the Congress in the same year established the Department of Agriculture with the directive that the general designs and duties of the Department shall be to acquire and to diffuse among the people of the United States useful information on subjects connected in the agriculture in the most general and comprehensive sense of the word Further the Commissioner for Agriculture was directed to acquire information which can be obtained by means of books and correspondence and by practical and scientific experiments by the collection of statistics and by other appropriate means within his power

Thus these two agencies started in the same year have revolutionized the development of agriculture in the U S A

The U S A Department of Agriculture consists of (*a*) eight large operating or program units which are named

(*i*) Offices including Extension Forest and Soil Conservation offices

(*ii*) Administrations including Farm Credit Farmers Union Production and Marketing Rural Electrification and Agricultural Research and

(*b*) in addition there are eight Staff and Service Offices at departmental level These are

Budget and Finance
Foreign Agricultural Relation
Information
Library
Personnel
Plant and Operation
Solicitor
The Bureau of Agricultural Economics

Of these the functions of the Extension Service and of the Agricultural Administration are of most interest to us for our present discussion

The latter consists of six large Bureaus *viz*

(1) *Agricultural and Industrial Chemistry* which deals with chemical physical and engineering research into the properties of farm commodities and the method

of utilizing such commodities The bulk of the researches in this Bureau are conducted in four Regional Research Laboratories, whose efforts are directed to discovering ways of utilizing specific agricultural commodities for food, feed and non food industrial purposes, especially of farm commodities in which there are regular or seasonal surplus

(2) *Animal Husbandry and Production*—deals with applied and fundamental research relating to the breeding, feeding and management of farm stock, except dairy cattle, poultry and fur bearing animals and the technology of animal products There are four regional laboratories

(3) *Bureau of Dairy Industry*

(4) *Entomology and Plant Quarantine*

(5) *Human Nutrition and Home Economics*—deals with (*a*) Basic human needs for food, clothing, housing and other goods and services and (*b*) Relative utility and economy of goods available for basic human needs

(6) *Plant Industry, Soil and Agricultural Engineering*—devoted to (*a*) Improvement of crop plant production, by reducing the hazards of crop production and improvement of yield and quality of crops There are three regional laboratories for basic research

(*b*) Soil Science deals with classification and improvement of soil, management of soil in humid and dry land regions, and under irrigation Study of basic soil plant relationship and research on the preparation, technology, and use of fertilizers etc There are two regional research laboratories devoted to basic research

(*c*) Agricultural Engineering devoted to engineering problem of primary processing of farm products, use of electricity, use of farm buildings and equipments and operation of farm machinery

Office of Experiment Stations—Its function is to direct as well to coordinate the researches carried out in the Federal Experiment Stations Its other function is to advise the State Experiment Stations, located in 'land grant' colleges, and to coordinate their work with those of the Federal Laboratories

It is stated that these Experiment Stations have been tremendously important to the development of scientific farming of the Nation The new and improved commodities and farming methods developed by these stations are outstanding examples of the great values which accrue to a Nation through scientific research. The importance of the stations can be scarcely over emphasized

Agricultural · Experiment Stations—The stations grew out of the 'land grant' colleges We have referred to the latter in the introduction to this section, and shall deal with them in detail later

Between 1862 and 1887 the Federal Government acted to extend agricultural experiment stations to all States and Territories with 'land grant' agricultural colleges, 14 States had independently established such stations. Besides a main station there are branch stations and field laboratories in different parts of the States, to suit differences in soil, climate and diversification of agriculture

Federal Grants for State Experiment Stations—The Hatch Act of 1887 appropriated $15,000/- annually to each State for the experiment stations The grant was increased progressively till in 1928, the authorization reached a total of $ 90,000/- per station per year The States have contributed 2 to 3 dollars for each dollar of Federal grant During 1947, the grant from Federal funds to the Experiment Stations was approximately $ 6 2 million, out of which about $ 3 1 million was utilized for background research, $ 2 95 million for applied research and only 0 15 million for development work

The research programmes of the State Experiment Stations include Industrial Utilization, Agricultural Engineering, Animal and Dairy Industries, Entomology and Zoology, Forestry, Home Economics, Plant Science Soil Science and Watershed Protection and Conservation

The Hatch Act also laid down specific authorization for scientific research at Federal Stations, the directives were mostly for applied and developmental character Later the Bankhead Jones Act of 1935 directed the Secretary for Agriculture 'to conduct research into laws and principles underlying basic problems of agriculture in its broadest aspects' and also 'authorized and directed (the Secretary) to encourage the same type of research in Agricultural Research Stations" *i e*, basic research was introduced in the latter

The role of the Federal Department in the administration of grants for financing the State Experiment Research Stations was also laid down in the Hatch Act of 1887, which directed the Secretary 'to indicate from time to time such lines of enquiry which shall appear to him most important and in general to furnish such advice and assistance as will best promote the purpose of this Act' In later Acts the Secretary was directed to coordinate 'the work of the Department of Agriculture with that of the State Agricultural Colleges and Experiment Stations"

In principle, it appears that there is nothing to differentiate the type of agricultural research undertaken by the Federal and State Departments of Agriculture The cooperative participation of the Federal Department of Agriculture is limited to problems which are common to two or more Stat's or are of regional nature,

Commodity Committees—In the Federal Department of Agriculture, there are a large number of Committees, of inter-departmental and of inter bureau character, which have been created to serve in an advisory policy making role to the Secretary of Agriculture Amongst these we select the twenty inter-bureau Committees, whose combined assignments encompass the entire commodity responsibility of the Department The Committees were established to bring together in one group, individuals from all research units with interests in one particular commodity Each Committee is concerned with recording the primary problems related to their commodity areas and recommending research programmes needed for their solution Through this method research programmes for cotton grain, rice etc are developed which cut across bureau lines and represent an integrated research programme Some of the commodities are

Poultry	Cotton	Grain	Citrus fruits	Peanut
Dairy	Flax Wool	Rice	Deciduous fruits	Treenut
Livestock	Tobacco	Potato		Dry Bean
Feed	Sugar	Vegetable	and Transportation	

Here there is no separation as in India into cash *and other commodities of which the former are under* semi autonomous All India Central Committees

Land grant Colleges—These were started as stated earlier under the Morril Act 1862 with Federal land grants There are now 70 of such Colleges and Universities Each State has at least one and in 18 States there are two In about half the States they are the State Universities all but two have Agricultural Colleges From 1887 Federal grants were given to land grant Colleges to launch Agricultural Experiment Stations Laboratories and experiment fields which provided the source materials for the entire land grant system of liberal and practical education Class room instruction and research stimulated each other Throughout the country land grant colleges pushed back the walls of intellectual darkness each discovery opening new potentialities The experiment was so successful that by 1914 the farmer s complaint was not that science was too slow or fruitless but the knowledge of the laboratories was fully 25 years in advance of general farm practices Hence they demanded that new steps be taken to make the results of science available to the men on the land

So the *Federal State Extension* system was launched Here was an unique land grant experiment An adult educational system reaching from laboratories class room and experiment fields to men and women throughout rural America In that half century the land grant colleges had enlarged and enriched all types of and phases of education not only at the college level but at the secondary school level as well The teachers trained in these institutions in agriculture industrial arts home economics basic sciences and liberal arts were introducing new courses into high schools just as extension agents were carrying information to the farms and homes of the land

'The land grant institution now enrol on their register approximately as many students as the other 1200 Colleges and Universities combined— about a million students '

The *agricultural programme of the land grant college is three fold*

(1) the Colleges/* or teaching division

(2) the Experiment Station or Research Institute,

(3) The Agricultural Extension Service

So far as one can make out the Experiment Station with branch station and laboratories in different parts of a State is the main if not the sole agency by which agricultural research is conducted in a State As a recent report states Research supported by State and Federal funds is frequently indistinguishable at the experiment station Different facets of a single problem may be supported both by Federal grants and State funds The same scientist may direct men paid by either fund The results of both are commonly utilized

The Agricultural Extension Service became another aspect of Federal and State cooperation The new knowledge about scientific agriculture as developed in the Experiment Stations are incorporated with instructions given in the Colleges This scientific information which is the basis of all progress in agriculture on the farms is supplied to the latter by the Extension Service which is a cooperation programme of the Federal Government and States and local communities The persons who carry this knowledge and demonstrate it to the farmers are called County Agents They are trained in the Agricultural Colleges and have a bachelor s degree in agriculture as minimum qualification They are appointed by and work under colleges Teaching of agriculture in rural high schools was given a stimulus by Act of Congress passed in 1917 Before this act was passed less than half the States gave any grant in aid to secondary schools for the teaching of agriculture The new Act appropriated Federal money for the preparation of teacher training in agriculture as a cooperative venture with teacher training institutions It carried the stipulation that funds appropriated for the preparation of teachers shall be matched dollar for dollar by the States or by local community or both At present 72 Colleges and Universities are training teachers and supervisors of vocational agriculture of this number 63 are land grant colleges

B *Reform in Agricultural Education in India*—The short account given above gives a picture of the key position held in the U S A by the land grant colleges in carrying on agricultural research in Experiment Stations incorporating the results in teaching of agriculture in training teachers for agricultural secondary schools and County agents for Extension Service It is not surprising that the American members of the Indian University Commission should place before their Indian colleagues the principle of land grant colleges as model for agricultural education associated with the proposed rural universities in India

Some of the Commission s recommendations on agricultural education are

(i) that as far as feasible agricultural education be given a rural setting so that it shall include direct participation in and experience with agricultural life and practices

(ii) that new agricultural colleges where possible be associated with new rural universities so that agri cultural education may be supported and enriched by contact with other fields and common use of personnel and equipment

(iii) that a widespread series of experimental farms be developed by the central and provincial Governments as resources and adequately trained men become available these experiment stations to represent all major types of soil climate crops and topography that as nearly as possible every basic elementary school every rural secondary and every rural university should have its own small experimental farm so that the spirit of research and experiment shall prevail all rural life and that where practicable every experiment station or college where student on work or study programmes may provide labour while becoming acquainted with experimental and research methods

Regarding existing agricultural colleges the Commission recommend that they be strengthened in equipment and teaching staff and that each one in addition to a programme of well proportioned general and agricultural education endeavour to find some phase of agricultural practice or some related interest like agricultural credit or agricultural cooperatives in which it shall undertake to achieve mastery Similarly the new agricultural colleges should explore some phase of agriculture or related interest often particularly related to its locality in which it will strive to become an outstanding authority

REFORM OF INDIAN AGRICULTURAL POLICY

Agriculture in the New Constitution—Subject matter of laws made by (Union) Parliament and the Legislature of States is defined by Article 249 of the Constitution There are three lists given in the seventh Schedule of the Indian Constitution of which list I contains the names of subjects which the Parliament is alone empowered to deal There is another list (II) with which the States (provincial) Legislature is alone empowered to deal While there is a third list (III) of concurrent subjects with which the Union (Central) and the State Legislatures can both deal

Article 48 provides The State (Union) shall endeavour to organize agriculture and animal husbandry on modern scientific lines and shall in particular take steps for preserving and improving the breeds and prohibiting the slaughter of cows calves and other milch and draught cattle

On looking through the three lists in seventh Schedule we discovered to our surprise that agriculture, which should be the responsibility of both the Union and the States does not find a place in List III of concurrent subjects On the other hand in State List II we find No 14 Agriculture including agricultural education and research protection against pests and prevention of plant diseases and

No 15 Preservation protection and improvement of stock and prevention of animal diseases, veterinary training and practice

In the concurrent subject List III the only reference to agriculture and animal husbandry is in No 29 Prevention of the extension from one State to another of infectious or contagious diseases affecting men animal or plants

The above noted ommission should be rectified and the sections 14 & 15 of List II should be transferred to List III

In implementing the changes suggested in the Constitution the following powers and responsibilities should devlove on the Union Government

(i) For the maintenance of administration bureaus and services on the lines existing under the U S A Department of Agriculture the different functions will be developed out of the existing machinery and taken up as resources and adequately trained personnel become available

(ii) In particular the functions listed under the Agricultural Research Administration of the U S A. and at present carried out by the All India Institutes for Research in Agriculture Animal Husbandry and Dairy Industry should be extended by the opening of a number of laboratories and experiment stations suited to the requirements of different regional areas of the country Such work should be in cooperation with State Experiment Stations and deal with problems affecting two or more States or of regional nature

(iii) Special regional laboratories for soil science and for watershed protection and conservation should be started

(iv) The distinction between cash and other agricultural commodities should be abolished If it is found necessary to continue for research and development purposes the imposition of cess on these commodities the total cess collected should be credited to a central authority who will be responsible for its utilization The Minister of Agriculture will be advised by suitable constituted Commodity Committees who will bring together in one group individuals from all research units with interest in one particular commodity These committees will be responsible for recording the primary problems related to their commodity area and research programmes needed for their solution

Agricultural research and development can be carried mainly through the agencies of the States Experiment Stations Plant breeding basic investigations on rusts fungi insects etc affecting economic plants storage of their products and similar investigations on animals and evolving methods for their prevention and control can best be undertaken by cooperation between Regional States and University laboratories specializing in such work

(v) Similarly the work of technological laboratories at present under Central Committees *viz* on Cotton (Bombay) Jute (Calcutta) Lac (Namkum) and Sugar (Kanpur) should not be confined to investigations on products of one economic plant or insect only They should be converted into large regional laboratories equipped for investigations of physical chemical, and engineering problems connected with and for the discovery of new uses for economic crops which are the speciality of each of the regions So far as possible duplication of work in the different regional laboratories should be avoided

(*vi*) The Union Government should be responsible jointly with State Government for the proper equipment and maintenance of State Experiment Stations State Agricultural Colleges for the training of teachers for agricultural secondary schools and for Extension work The I C A R is at present discharging not very satisfactorily some of these functions Further extension of its powers on the lines of the Federal Office of Experiment Stations of the U S A is necessary

(*vii*) The responsibility of the Union Government for (*iv*) will in part take the shape of grants to the States which will be matched by similar grants by the latter and other local agencies The other part of the Union's responsibility will be to provide machinery for supervision and coordination

The problems of agricultural administration of this country with its peculiar social and economic structure and its traditional agricultural practices are vast and complicated We have suggested certain changes of Constitution and administrative reorganization and expansions and a new adjustment of the activities of the Union and State departments of agriculture with a view to securing expansion better rationalization and coordination of their respective functions These proposals require to be supplemented by detailed studies one of the most important and complicated of which is the machinery for Extension service which in view of the small holdings and present illiteracy of the cultivators must go much further in directions not considered necessary in the U S A In most of the Central and State agricultural departments there has been many failures in the work of extension

It is over 20 years that an Agricultural Commission was appointed to examine on the state of agriculture and rural economy of the country The Famine Commission of 1944 has done valuable work in this direction Probably the appointment of a Committee to report on the overhauling of the machinery of agricultural administration (both on Union and State levels) on the lines discussed above may be desirable

C *Rural, Secondary and University Education*— In B' we quoted some of the important recommendations of the University Commission on Agricultural Education (Chap VII) They were based upon an adaptation of the structure of land grant colleges to our local conditions We are told that these land grant' colleges provide 3000 occupations including such as are suitable to students from agricultural vocational schools who desire to specialize in different aspects of agriculture The Commission recommended that the new agricultural colleges where possible, should be associated with new rural universities, so that agricultural education may be supported and enriched by contact with other fields and by common use of personnel and equipment In Chapter (VIII) on Rural University we did not discover any coherent scheme of rural collegiate education correlated with agricultural education and extension work It appears to us that Chapters VII & VIII were written by different members of the Commission and no attempt was made subsequently to fuse them into a coherent system This has to some way detracted from the usefulness of the Report

The whole of rural education is divided by the Commission into

8 years of basic education
3 or 4 years of post basic or secondary education
3 years for college and
2 years for post graduate university work for master's degree

The expression college in this connection refers to not only to education leading to an academic degree but to any education beyond the secondary school whatever may be its form

Adult education through People's College—

The Commission views the possibility that a large proportion of Indian rural boys and girls may not attend formal school beyond the seven or eight years of basic education The Commission suggest that for such people some form of adult education may be arranged similar to that provided by the People's College of the Scandinavian countries especially of Denmark

People's College of Denmark are residence institutions for adult young people chiefly from rural life They are not vocational but cultural in their purpose All of them and of the Agricultural Schools are private institutions usually owned by principals but sometimes by an association A People's College applying for public funds must be first recognized by Government

While the Government allows a certain proportion of students under eighteen the People's College are conducted on the assumption that it will be well to have a break in schooling between the 14th and the 18th year or longer Many Danes hold that during this period between adolescence and maturity young people want to grapple with practical affairs to become self sufficient and self reliant It is felt that students should first learn the manual labour of their future occupation and should not attend People's College unless and until they have a strong desire for education There is no space here to evaluate the results of the People's College movement Their alumni have taken leading role in the cultural achievements of the country in initiating social legislations and in helping the economic development of the country The Commission does not however indicate how the proposed rural universities will help in the starting of any adult education movement in this country on the lines of the People's College

Basic Education—To see rural higher education in good perspective it is considered necessary to have some idea of the elementary and secondary education out of which it should emerge The Commission consider that the programme of Basic National Education for grades one to five, may be considered as a representative statement of what basic education for rural areas should be This programme is in practice in several parts of India, and appears in main to be justifying the expectations of those who gave it form A possible criticism of actual practice is, over emphasis on one process of producing fabric and cloth 'In some ways it seems desirable that a more distributed interest and attention to varied processes of rural life would be desirable' There is no attempt to indicate how the agricultural activities can be made to provide such interests

As post basic secondary school programme has been less carefully worked out and while that of higher education has not been clearly formulated, the Commission proceed to consider them in detail

Rural Secondary Schools—A successful development of secondary rural education should presume decentralized well balanced progressive industrialization In fact a considerable part of the vocational training of post basic school should be to prepare boys and girls, no longer needed for agriculture, for other callings The industrial development of India is being handicapped by the lack of workers who are skilled in hand and eye, to fill positions not requiring full professional training As rural industries develop the rural secondary schools should go far to meet that need Again we miss here any references to special types of agricultural vocational schools necessary to provide

(i) Training to sons of yeomen farmers, to fit them to become better cultivators of land ,

(ii) Training for village guides who will pass on to the cultivators all the information about improved agricultural technique in State and agricultural college experiment stations and

(iii) To provide overseers for such stations

Amongst the number of types of rural secondary schools which will emerge as the general principle of basic education find expression in practice the Commission selects one type for detailed consideration Such a school should unless there are good reasons to the contrary, be residence school with pupils living in hostels or if feasible, in such houses as would be suitable for good village life On the other hand it is important that school experience shall not divorce him from his village associations so that he cannot return to work in the world from which he came

The secondary school village would as a rule serve a group of villages and should be conveniently situated with reference to them It will cater for 150 to 200 students, and will require 30 to 60 acres of land, of which 10 acres should be used for school house, hostels, homes for teachers, play grounds, workshops and industrial sites The rest should be for agriculture, forest and pasture All this is very desirable, only the cost of starting and running such schools in large numbers appears to be prohibitive Certain suggestions are given for reducing the cost of construction *e g* , by making the pupils and teachers take part in building the school village, with the help of a person trained in village and school planning Further the life of the school should follow the course of life of a good village, except that about half the working time should be given to study, and about half to practical work There are some kind of work with which nearly every pupil should become familiar, such as child care, cooking, and keeping of home for girls, and agriculture and the use of household tools for boys and girls The school should raise most of its food and should teach boys and girls how to make the land yield as much as possible The practical work should include farming, building, carpentry, housekeeping, weaving, street cleaning, and other useful village work It should also include one or more modern industries, manufacturing goods for sale

Rather than work and study for a part of each day, it probably will be well to divide the students into two shifts, each shift studying and working on alternate days or more probably alternate weeks or fortnights For many of the pupils the secondary school period would complete the schooling and their special training Others would find it desirable to go to more advanced rural schools or colleges

A syllabus is given of the more formal type of education to be given in these schools, both for the imparting of information and what is more important the development of attitudes of mind and spirit

Other topics like self support in Basic Education and Division of Labour in Basic Secondary Schools are discussed in the Report, into which we cannot enter for want of space A very attractive picture of rural secondary school is presented in the Report, it will require to be tried in specially selected rural areas, as pilot scheme, for tests,

(i) regarding the cost involved,

(ii) on the development of cooperative building and other practical activities amongst the teachers and pupils and

(iii) on the feasibility of combining the formal and practical portion of the training as mapped out with the capacity of the pupils to assimilate the training within 3 or 4 years of post basic education

Rural Colleges and Universities—As a general type of arrangement it is suggested in the Report that a rural university should include a ring of small resident undergraduate colleges, with specialized and university (post graduate) facilities in the centre The number of undergraduate students in each college should be about 300 and the maximum overall enrolment for colleges and university combined about 2500 This arrangement will combine the advantages of small resident undergraduate colleges where there are close relations between teachers and students with the advantage of fully developed university which offer a wide range of specialized and advanced educational opportunity to advanced students or to other students with specialized interest

The aim of each college would be to equip its students with general educational foundation and to encourage the development of individual aptitudes and interests as they appear A great deal of flexibility and adaptability in the courses to be offered to the students is recommended While there should be many elements common for all students the curricula should be made to fit the needs of individuals and not to make the students to conform to an arbitrary curriculum Each student should be given the opportunity, without sacrificing the general core of education to begin specialization at whatever time he is ready for it even at the risk that he might later change his field of occupational interest Some students have clearly defined occupational interests at an early age

The other important recommendation is that in rural colleges as in rural secondary schools general studies should be united with practical courses so that those who attend college should become cultured educated men and women and also persons trained and skilled in some field or prepared for further advanced training Probably the greater part of rural college students will not have further schooling except for refresher courses and so their college courses should include occupational preparation Also as with rural secondary students rural college students may spend about half their time at studies and half at practical work The working and study period should be longer than in secondary schools, the interval between work and study being perhaps 5 or 10 weeks each This programme of work and study has been developed in some places in Europe and America, through more than 35 years and has been successful In America a steadily increasing number of universities technical institutes and similar institutions now use it

'There is a tendency in University circle which look upon alternating work and study and also upon 'practical courses especially those calling for manual craftsmenship as suited to inferior minds while professional courses are for intellectuals This separation of skill of hand from skill of mind has greatly retarded the mastery of the physical world and has been the major cause of poverty, especially in India Practical skill should be looked upon as equal in dignity and worth to purely intellectual skill Like scholarship it should be recognized with ascending grades of achievement and opportunity, so that the man who develops high ability with hand and eye may have an open road to advancement equal to that of the purely intellectual worker' Examples cited in the Report to support this view are the great contributors to astronomy who have based their work on mechanical skill Charles F Kettering the famous General Motors Manager and Henry Ford in their earlier years worked out ideas with their own hand as mechanics

Ways and Means—As to ways and means of getting the rural education programme under way the Commission remarks The criticism would be made that while the programme outlined would be a desirable one India does not have the resources to put it into effect Most of the provinces are already committed to the principles of basic education Each of them might well establish a number of resident secondary school villages and they might cooperate in establishing one or more rural universities Similarly the Central Government might well establish several resident secondary school villages and a rural university The growth of the new system will depend largely on the supply of suitable teachers The Central Government or the Provinces might establish one or more training schools for teachers of this programme

'The Gandhi Memorial Trust might well establish several secondary school villages over India and one rural university staffing them with persons trained in existing training centres and with others who are sincerely committed to the principles of basic education It will be no disadvantage for the programme to have varied independent beginnings The new type of secondary schools and universities should be vigorously developed as essential element of the educational expansion on which the future of India depends'

We bring our survey of 'Agricultural Education and Research in India' to a close with the above extract The proposals for rejuvenation of rural education and the starting of rural universities are too complex to be described adequately in a few paragraphs or can be assessed at the tail end of our present review If occasions arise we hope to return to it again

D M B

References

1 Report University Education Commission 1948 49 Vol 1
2 Report Calcutta University Commission 1917 19 Vol 3
3 The Famine Inquiry Commission 1945 Final Report
4 Report on Post War Educational Reconstruction Central Advisory Board of Education
5 Report on Post War Agricultural Reconstruction I C A R
6 I C A R Organization and Functions Part I 1948
7 Education in Modern India Anath Nath Basu 1946
8 Science and Public Policy in U S A Steelman Report Vols 2 and 3 1947

IS COMMUNAL CONFLICT OR WAR INSTINCTIVE ?

K C MUKHERJI

DEPARTMENT OF PSYCHOLOGY, CALCUTTA UNIVERSITY

INSTINCT refers essentially to a conative impulse which man inherits for the satisfaction of his most fundamental needs of life So instinct is in the individual s psychological make up Aggressiveness is regarded by McDougall to be an unit of this make up But killing is not the only manifestation of human aggression Litigation in the defence of one s own interest and political campaign not leading actually to any war also come of the aggressive impulse Even intellectual endeavour to understand and master the environment is considered sublimated manifestation of the aggressive impulse So the mere fact that man has aggressive impulses does not necessarily imply that war is inevitable and unavoidable Thus war is not a co existent factor of aggression In fact war may come out of some specific conditions which it is not possible for one to establish from the study of the individual s psychological make up The American history shows generally a peaceful state of human affairs—quite different from the state of mind which the people of Europe present These people deriving from the same stock behave differently in different countries not because of any changed psychological structure, but because of the different socio-political conditions under which they live So the basic human factors remain almost constant while the sociological factors are the variables But Freud finds in this basic human nature the unavoidable element of war According to him war is the unavoidable manifestation of man s innate destructiveness He believes that destruction for its own sake is one of the strongest human motive forces In international wars this self destructive tendency of the people is indeed deflected to an outward object So according to Freud the innate destructiveness of man causes war and war is unavoidable Men must hate and destroy something Only if they have a common external object of hate can they be saved from each other s destructiveness Leaders understand this instinctively , and in order to avert revolution they institute war

This is not the place to discuss Freud's problematic death instinct theory But even if it is true that man is innately destructive and that war is the manifestation of destructiveness it does not necessarily follow that man will always have to conduct wars We observe that Freud has studied the manifestation of this destructiveness under different conditions and found that this destructiveness might be diverted towards external objects [1] But he has not discussed the necessary relationship of this destructiveness to war So war as a manifestation of this destructiveness may occur only under certain social conditions—national or international It is not well known whether an innate destructiveness for its own sake goes beyond the limits of self preservation The relationship of aggressiveness to self preservation is still uncertain But there is no doubt that a destructiveness for its own sake may exist as a secondary phenomenon in the form of sadism This sadism is often considered as a secondary erotization of an originally self preservative aggressiveness It seems that in morbid development, when a large quantity of inhibited hostile impulses accumulate these may be drained by sadistic behaviour which serves merely as a gratification and not for self preservation So even when destructiveness for its own sake causes war or hostile conflicts it is under special conditions of life that such development arises

So the conditions of war like conflicts may primarily be mental or environmental Though the conditions of the two kinds are not exclusively separate but still their relative importance in the determination of conflict or war varies in different cases When the emphasis is made on the environmental factor it means that the existence of a particular people is threatened by particular environment that is to say, when a people endeavours to ensure its existence its endeavours conflict with the strivings of other peoples subjected to the same environmental forces Thus we find that when an environment is brought about by the strivings of a people in its struggle for existence— rendering it difficult for other peoples to adapt themselves to it, then an attempt is made to alter that environment, but this attempt is resisted by the people who consider that any alteration of the environment will affect its own existence As a result communal conflict or war follows This is an economic crisis which it is difficult to prevent through psychology

But Freud in a letter to Einstein holds that 'conflict of interest among mankind is in the main usually decided by the use of force This is true of the whole animal kingdom from which mankind should not be exempted' [2] It means that war is the usual way of settling conflicts between groups This view tends to refute those who seek the causes of war in a specific emotional disturbances of the masses and refer to it as a mass psychosis We observe communal conflict often come out of a mass psychosis In this conflict the aggressors as individuals remain relatively normal, well adapted persons They go about their business, take care of their family and so forth But it is only when they join a group, when they become members of a mass, they lose certain qualities which determine normality and thereby become instrumental in helping to produce a mass delusion, belief in which is shared by all the other group members their delusion is a mass delusion and may not be effective individually under the test of reality Individually there may remain a few persons who may have friends among the members of the other community whom they hate collectively But these few people may be influenced by propaganda through newspapers leaflets etc and may believe in the wickedness of the members of the other community without argumentation Thus they become intellectually participant in the mass delusion without active cooperation with the mass This mass psychosis which operates in the origin of communal troubles is distinct from the individual psychosis and so we find that a delusional disorder of the mass mind may leave the individual mind still intact

---

[1] Why war' (Paris International Institute of Intellectual Co operation, League of Nations, 1933), pp 3 9

[2] *ibid* , p 3

To understand this mass psychosis we should try to analyse the basic complex of the individuals actively participating in the communal massacres So our endeavour will certainly be misdirected if we merely embark on an investigation of the various accusations brought against the members of one community by the others False accusation is bound to occur in the communal conflicts The differences in habits and ways and says of life differences in wealth culture and status cannot adequately explain the original cause of communal bitterness because these differences exist among the members of the same community But we find that when these differences are irrationally exaggerated and used as a weapon in the hands of the politicians when false charges and irrational indictments are made by the leaders they are accepted by the mass mind and communal fury follows We shall try to know the mental mechanism that allows the false charges and calumny to spread like an infectious disease and produces such a delusion in the mass mind that an unrestricted discharge of destructive aggression follows It has been already pointed out that this aggressive destructiveness is due to the delusional disorder of the mass mind The individuals come under the spell of this delusion when they join the mass This psycho pathological disturbance of the mass mind is not a mass neurosis it is a mass psychosis for the very essence of a neurosis is that it afflicts the individual with inhibitions and makes him asocial an outsider to the group So the neurotic individuals cannot form a group A psychosis is specifically precipitated by a break of the ego with reality A break with reality means that the individual withdraws his instinct cathexes from the objects of his present world and allows his ego to escape from reality by regressing emotionally to a past level of his childhood—the stage of narcissistic self love So the psychotic ceases loving the object and loves only himself object libido becomes transformed into narcissistic ego libido The over abundance of narcissistic self love makes him megalomanic and he becomes unconscious of his failure to struggle with reality The relative incapacity of the psychotic to adapt to reality precipitates all his mental disorder by impelling his ego to escape through the avenue of infantile regression This regression goes so deep that the peculiarities of primordial narcissism in which hatred governs the environmental relationships develop in the ego This stage of narcissism is both an ontogenetic and phylogenetic phenomenon and it is this pathology of hate which lies at the basis of communal conflicts in man In this stage of primordial narcissism there is no barrier of repression for the pre morbid ego of the psychotic in its trend to regression cannot afford that expenditure of energy necessary to sustain the defence mechanism of repression So the super ego of the psychotic is not strong and effective In fact the psychotic ego regresses to the infantile stage of development where there is no super ego—or where its governing power is still represented by the parent So Freud has shown that the mental energies from which we build the intra psychic power of our super ego stem chiefly from the introversion of suppressed aggressive energies specially those which we were forced to deflect from our parents The ego allows these introverted aggressions to be made over to the super ego While submitting to this inner parent the ego perceives its aggressions as pangs of conscience or as feelings of guilt But in the process of the deterioration of the psychotic ego system the super ego gradually succumbs to it So the ego loses its orientation toward reality as well as the capacity to differentiate between the external object reality and inner irrational psychic reality The psychotic then sees the object world in terms of the irrational imagery of his unconscious But all the images which populate the world of the psychotic are in essence representative of but one figure—that of the parent The ego breaks down because it cannot solve its conflict of ambivalence of loving or hating the parent This latent ambivalence conflict with the parent which precipitates psychosis in the individual by a break of his ego with reality is split up in the individual through participation in the collective ego of the crowd The parental power of the unconscious of the individual is re extroverted into the leader whom he loves and into the people of the other community whom he chooses as the object of his hatred So the mass leader represents the beloved parent in whom the child needs to believe for the sake of his own security By becoming a member of the mass and accepting the mass leader as the external parental representative the individual becomes a child for the period So the individual inner super ego disappears all his inner responsibility is thus off the barriers of repression are lifted and the instinct force of primitive hate and destruction unleashed This release of repression allows the unconscious materials to enter the conscious ego and the conscious ego becomes subjected to drives and wishes of the inner irrational psychic reality So the individuals as the members of the mass believe in all false accusations especially conveyed by the leader against the members of the other community not inspite of but because of their irrationality So LeBon describes the leader as follows ' The nimbus of the leader is sustained only if what he says is unreal incomprehensible and beyond discussion The mass can believe in what he says only when his speech appeals merely to beliefs and not to approval by argumentation According to LeBon it is not what is real that counts but only the unreal matters in the mass So the crowd is incapable of distinguishing subjectivity from objectivity So the mass suffers from paranoic delusion and wanders along the borderland of the unconscious because it is governed by instinctual drives of destruction and wild ness, which' as LeBon holds, 'slumbers in everyone of us The crowd man thinks and acts completely under the spell of the primary processes in the unconscious instead of responding to the categories of logic ethics and aesthetics which govern our conscious mind So the regressive conscious mind of the crowd man thinks and acts irrationally For the crowd mind this regression is temporary but during this period of their temporary regression the members of the mass who feel individually powerless overcome their actual infantile impotence by submerging their individual egoes into the collective ego of the group and care for no obstacles in the way of their action impulses The restoration of this infantile mass—regression to normalcy is at present the problem of the day

But behind this mass regression and collective discharge of aggressive energies there is the pathological group formation The crowd mindedness of the people is responsible for all communal riots and conflicts So LeBon expresses the fear that the crowd mindedness of modern man will bring about the destruction of civilization It is the immaturity of individual egoes that make the individuals a more easy prey to the crowd mind The egoes are immature as a result of their super ego weakness An ego is mature if it has developed a strong and effective super ego as the internalised representative of the external parental power This super ego checks the infantile regression of the ego by helping the ego to test reality and to act in accordance with this testing So the aim of all measures against communalism should primarily be the effective development of this social super ego in men so that they are equipped for reality testing But there is no mechanical process for the development of a lasting reliable strong super ego in men Extensive researches on the analysis of different afflicted persons should be undertaken in India in order to understand and combat their mental complexes Even children should not be neglected in this work The reduction of destructive tendencies into constructive channels courses in social living and imparting knowledge of the psychological facts of life should be the educational task so that the basic preparation for the mature development of the super ego may begin early in life The old system of totem feasts at regular intervals and of dramatic performances which we call in Bengal *Jatras* seem to be useful instruments for the introverted making over of the pent up aggressive energies to the super ego In *Jatras* the audience indentifies itself with the tragic hero who commits terrible crimes and succumbs to the consequences of his guilt In watching the performance of the drama the audience by way of fantasy identification with the hero in his crime and in his downfall and guilt feeling is enabled to re introvert the aggressive energies and consequently to augment the strength of the super ego At present the aim of the theatre is to offer the people what the people like without considering what the people need The aim of the games should similarly be not merely to test the relative strength of the contesting teams but the emotional enthusiasm of the people should be utilized on a mental plane after the discharge of their aggression so that the minds of the people are carried from the spirit of competition to the spirit of cooperation and they feel united in love with one another by participating in songs speeches theatrical performances etc It has been pointed out that the communal propaganda becomes most effective if it is irrational and appeals to the unconscious of the mass especially in the cheap locals where chronic alcoholics addicts and psycho pathic criminals gather These psychological slums which breed hate and destruction need mental sanitation just as the unhygienic living quarters need to be weeded out of swamps in order to combat malaria or tuberculosis In communal fury we have observed that man as an infantile individual feels weak so he flees into the mass and feels so overwhelmingly powerful that—whatever he might do—impunity is assured to him But when the emotionally regressive individuals are not sure of this impunity and the government lends its strong support to the minority making it as powerful as its opponents the immature individuals may then feel less tempted to become crowd minded So *Mahatmāji's* move for the safety of the minority in Noakhali Calcutta and Delhi was most psychological and greatly effective The opposition of violence by non violence is indeed a phenomenon of the inner conflict of ambivalence in man but the phenomenon of unrestricted discharge of destructive energies occurs for the lifting of the barriers of the super ego which *Mahatmaji* as a re extroverted super ego desired to restore in the mass mind So this was a most psychological intuition for *Mahatmaji* to feel that 'that which can be exercised only among friends is of value only as a spark of non violence while the greatest enmity requires an equal measure of *ahimsa*[2] to be cultivated in several births of generations in an atmosphere of purity and discipline[3] To establish this intuitive vision of the internalised super ego *Mahatmāji* possessed and to utilize its truth to the benefit of the people a scheme of work on the analysis of afflicted persons was necessary Distinguished psychologists and psychiatrists should be employed to study the importance of this epoch making theory *Mahatmāji's* disappearance may cause the disappearance of this vision unstudied but history will reflect on it Science always entails for its success a huge waste of money and energy

---

[3] No Limitation *Harijan* December 14 1947

FOREST ECOLOGY AND EVAPORATION MEASUREMENTS IN INDIA

G S PURI

FOREST RESEARCH INSTITUTE, DEHRA DUN

IN a recent paper Ramdas (1949) recommended that a network of evaporation recording stations be set up in India to providing adequate data for use in Agriculture and Hydrology He says and besides the evaporation records measurements from soil surfaces (with soil evaporimeter sets) as well as seasonal variations of the depth of water table etc should be made (p 174) This suggestion is very welcome to ecologists soil scientists and all those who are engaged in the study of vegetation in relation to habitat factors

Evaporation or more accurately speaking a ratio of Precipitation/Evaporation is one of the major ecological factors governing the development of both soil and vegetation

In humid regions especially in higher latitudes where this ratio is high the chief trend of development in the soil is leaching as a result of which woodland soils with advancing age become impoverished at the surface of soil bases especially calcium Depending upon the amount of calcium present in the rock most forest soils under natural conditions tend to develop a podsolic profile and running parallel to the development of the soil there occur corresponding changes in the development and succession of vegetation For example immature or new soils in humid countries of Europe (*e g* in the English Lake District) are less base deficient and support the growth of ash ash hazel or ash hazel elm type of mixed woodland with exacting requirements on soil bases (Puri 1949b 1949e) This type is however succeeded in time by oak oak brich or in the south of England by beech holly communities which requires lesser amounts of calcium for their growth (Puri 1949c) On reassorted soils or those derived from rocks poor in calcium *e g* Bagshot Sands the final stage is the conversion to healthy conditions where the soils become very acidic on the surface with a bleached A horizon and enriched B layer with iron or humus pan In such areas roots of trees cannot penetrate to great depth in the soil unless hard pan is physically broken to enable them to reach the lower layers

In regions with a low ratio of Precipitation/Evaporation the chief trend in the development of the soil is evaporation, by which mineral salts from lower layers of the soil are continually brought to the surface Some of the forest soils in tropical climate of Northern India therefore become enriched with bases in the course of their development It is on account of high evaporation from the soil that surface layers in most types of our forests, even in hills at high altitude are base saturated and show a poorly developed profile The data of Griffith and Gupta, 1947 Taylor and others 1936 Hoon, 1939f, Puri, 1949, etc , agrees with the argument developed here It may be pointed out that some high figures for exchangeable calcium obtained by Hoon in surface layers of some soils may be partly due to high amount of Ca present in leaf litter of the existing vegetation

An illustration of this type of development in the soils and vegetation may be found in the Kulu Himalayas where freshly laid immature soils rock screes or sandy alluvia are colonised by the chir pine (*Pinus longifolia*) a non exacting species This is succeeded by Kail (*Pinus excelsa*) and deodar (*Cedrus deodara*), species with higher requirements for soil bases which become available to the seedling growth at the surface layers of the soil through evaporation and leaf litter (Puri 1949f 1950c) Fire is also considered by forest officers to play a notable role in the occurrence of those species but the action of fire in this case is similar to that of high evaporation

At higher altitudes in the main valleys or in side valleys in the Kulu Himalayas there is a higher precipitation as a result of which the surface soils tend to be leached of minerals The development of vegetation in this region is similar to that of Europe and proceeds from broadleaved species of *Cornus macrophylla Prunus padus Juglans regia Aesculus indica* etc with high lime requirements to spruce and silver firs whose demands on soil minerals are low (Puri *loc cit*) Similar sequence is seen in the Kashmir valley (Hoon *loc cit*) and it seems that the development of soils and vegetation is related to the ratio of Precipitation and Evaporation

In lateritic soils under teak in warm tropical climate of S India the data of Griffith and Gupta (1947) shows that a change in Precipitation/Evaporation ratio by opening the canopy and increasing evaporation from the soil brings about a deterioration of soil for this species and encourages growth of other species

The importance of Precipitation Evaporation ratio in the development of vegetation and soils is abundantly recognised in Europe (see Stamp 1947 p 92) and this knowledge is applied to scientific forestry and agriculture in most countries In this country however on account of diverse climatic conditions and lack of adequate records of evaporation (and even rainfall at some places) the significance of this factor in the development of forest vegetation and soils has not been properly appreciated

My preliminary survey of sal forests in the Dehra Dun valley and available data of Griffith and Gupta as indicated elsewhere (Puri 1950a d) tend to show that the failure in regeneration of *Shorea robusta* in places which have been over exploited is perhaps related to a change in this ratio Under close canopies of pure sal where the soil is little exposed to sun there is less evaporation Surface soils in such situations are acidic and have low amounts of calcium and high amounts of nitrates Under these conditions (see table III on pp 22 23 in Griffith and Gupta *loc cit*) it is seen that the regeneration of *Shorea robusta* a non exacting species with only 1 46% of foliar Ca as compared to 2 6% in most of its associates is present An injudicious opening of canopy would increase evaporation as a result of which surface soils become saturated in bases and thus allow the growth of only exacting species at the expense of sal (Puri 1950a d)

Changes of a similar nature seem to be working in conifer forests of the western Himalayas as well where one species or the other fails to regenerate after felling operations The author s studies on these lines in conifer forests of the Kulu and Parbatti valleys are in progress and the preliminary results which closely agree with those of Taylor *et al* (1936) already seem to show the causal relationship between precipitation and evaporation and growth and regeneration of various conifer species

The examples given above seem to show clearly that exact data on evaporation and rainfall over small areas in a forest are essential for successful silviculture of our important timber species Ramdas s suggestion for collecting evaporation data embraces only agriculture areas but it is highly essential that similar evaporation measurement stations be set up in important forests of India Provincial Forest Departments maintain *records of rainfall at their offices and Rest Houses* in the forest and at some places temperature measurements are also taken It would be of immense interest to have soil evaporimeter sets at such places to begin with and to extend observatories to other areas in the forests later on The cost of providing such an apparatus as given by Ramdas (about Rs 500/ /) is negligible as compared to the value of the data in forest management growth and regeneration The Meteorological Department may perhaps advise the Forest Department in regard to the extension of their service of soil evaporation measurements for mutual benefit since observations from agricultural stations alone will perhaps not give satisfactory results for assessing the effect of climate on vegetation

The ratio of Precipitation/Evaporation could be of wider application in Ecological Soil Survey in relation to agriculture forestry and land conservation *Being faced at the moment with shortage of food* wood and fuel we should be interested in putting all available land under vegetation and for this purpose it is necessary to study potentialities of land and soil climate vegetation complex on a long term basis The importance of Precipitation and Evaporation measurements on more accurate lines is thus obvious in the natural economy of our country

The first attempt at understanding the climate of India on the basis of Precipitation/Evaporation was made by Raman and Satkopan (1935) who used the single value factor the annual rainfall minus the annual evaporation for records of 80 different stations in the country At about the same time Hosking (1935) calculated climatic values for regur soils of India for comparison with black earths of Australia and his studies culminated in 1937 in the preparation of a map of India showing Meyer Ratio of Precipitation/Saturation deficit This map shows the minimum value of Meyer ratio of 5 for central part of Sind and the maximum value of 4000 for Cherrapunji which records the maximum rainfall in India

Hosking s map of Meyer ratio was used by I C A R in making the first soil map of India in relation to *climatic zones This map however is preliminary* and does not show any clear correlation between different types of soil and Meyer lines and relation between vegetation and these lines is still less evident

A good deal of work has been done in Australia to express Precipitation/Evaporation ratio more accurately with a view to correlating it with different types of soil and vegetation and Prescott (1949) has recently brought forth this relation in an excellent paper which should serve as a type study for work in this country Prescott states that the most efficient single value climatic index is P/E^m where P represents precipitation E evaporation from a free water surface and m is a constant varying from 0 67 to 0 80 with a probable mean of 0 73 A value for this index of 1 1 to 1 5 corresponds to the point where rainfall balances transpiration from vegetation and evaporation from the soil (*loc cit* p 19)

The Government *of India* has set up a central committee on soil research (1949) one of the aims of which will be to advise planning of soil surveys and the preparation of soil map of India It is hoped that this committee will remember the interests of Ecologists (Puri 1948) and Foresters and recommend an ecological approach to the survey of soils Soils being dynamic systems must be examined surveyed and classified not only in relation to climatic (Precipitation/Evaporation ratio) but also to vegetational biotic and historical factors The advantages of ecological approach in this survey are obvious since its aim is primarily to use the soil for the maximum production of agricultural or forest crops without impairing in any way its productive capacity for future use

The ratio of Precipitation/Evaporation is one of the important ecological factors governing the fertility of the soil hence it may be stressed that to aid (*i*) Successful forestry (*ii*) Soil survey and (*iii*) Soil conservation the service of evaporation measurement stations be enlarged so as to embrace forest areas as well

REFERENCES

Hoon R C (1939) A study of the soils in the hill areas of Kashmir *Ind For Rec Silv Series 3* 6

Hosking J S (1935) *Trans Roy Soc S Aust 59* 168

Hosking J S (1937) The ratio of precipitation to saturation deficiency of the atmosphere in India *Curr Sci 5*

Griffith A L & R S Gupta (1947) The determination of characteristics of soil suitable for sal (*Shorea robusta*) *Ind For Bulletin* 138

———— (1947) The characteristics of teak soils with special reference to laterisation *Ind For Bull*

Puri G S (1948) A plea for the establishment of Ecological Survey of India to conduct researches in applied plant ecology in relation to forestry agriculture and soil conservation' paper submitted to the Government of India, Ministry of Agriculture, through the High Commissioner for India in London

———— (1949a) The ecology of erosion and land slips, *Journ. Ind Geog Soc*, 24

———— (1949b) The ash oak woods of the English Lake District, *Journ Ind Bot Soc* 28

———— (1949c) Surface Geology, vegetation and plant succession *Proc 36th Ind Sci Cong*, III, 149

———— (1949d), The historical factor and its application to forest ecology, *Journ Ind Bot Soc* 28, 63

————(1949e) The Vegetation of some disused quarries at Ingleton, Yorkshire, England, *Journ Ind Bot Soc*, 28

———— (1949f) Physical Geology and Forest Distribution *Science and Culture*, 15, 183

———— (1950a) Ecological approach to the problem of sal (*Shorea robusta*) regeneration in the United Provinces Part II, *Proc 37th Ind Sci Cong*, III, 64

————(1950b) Conifer forests of the Kulu Himalayas, *Proc 37th Ind Sci Cong*, Poona

————(1950c) The distribution of Conifers in the Kulu Himalayas with special reference to Geology *Ind For*

————(1950d) Soil *p*H and forest communities in the Sal (*Shorea robusta*) forests of the Dehradun valley, U P, India. *Ind For* (*In Press*)

Prescott, J A (1949) A climatic index for the leaching factor in soil formation, *Journ Soil Science*, 1

Raman, P K and V Satkopan (1935) Science Notes', *India Met Deptt* 6, No 61

Ramdas L A (1949) Evaporation measurements in India, *Central Board* of *Irrigation Journal* 6 2

Science Notes and News (1949) Central Committee on soil research *Current Science* 18 7

Stamp, L D (1947) Britains structure and scenery, *The New Naturalist* 4

Taylor, M I D Mahendru M L Mehta and R C Hoon (1936) A study of the soils in the hill areas of the Kulu forest Division, *Ind For Rec Silv*, 1 2

INDIAN WEATHER AND LOCUST IMMIGRATION IN INDIA*

R V BADAMI

NAUTICAL AND ENGINEERING COLLEGE, BOMBAY

From the climatic point of view, the outstanding feature which distinguishes the Indian region from other parts of the world is the monsoon which represents interactions between the air masses of the two Hemispheres Its advent in June and retreat in September are known as the transition periods In some years the fluctuations associated with the first transition may commence as early as in April and those with the second may not cease until October

So far as Rajputana is concerned, the immigration of locusts appears to synchronize with the first transition and emigration with the second transition This of course is a generalization, departures from which in individual years should furnish a valuable basis for the correlation between the habits of the locusts and the deviations of the various meteorological elements from their respective normals This note is however mainly concerned with average conditions

The home of the monsoon winds in India is to the south of the Equator The monsoon current is popularly known to have two branches, *viz*, the Arabian Sea branch and the Bay of Bengal branch

As a southwesterly current, the Bay of Bengal branch strikes Tenasserim in April or May It then proceeds as a southeasterly current through Burma, and the U P and reaches the Punjab and Rajputana by June or July. From the point of view of heavy rainfall, this branch in association with a monsoon depression is important for the Rajputana desert A monsoon depression usually travels from the north-west angle of the Bay of Bengal, off Orissa, towards Rajputana

The Arabian Sea branch of the monsoon, on the other hand, strikes Malabar as a southwesterly current by June, and gradually extends northwards to Gujerat, and then proceeds towards the eastern Himalayas across Rajputana In some years, the Arabian Sea branch causes early monsoon rain in Rajputana

The advance of the monsoon into Baluchistan is of very short duration and erratic in character It may be said that on the average the monsoon does not last over the Baluchistan hills for more than five days The monsoon rainfall extends to the Mekran very occasionally, indeed the number of rainy days in this area and further west in Persia is even smaller and therefore negligible

On the eve of the establishment of the monsoon, there is a low pressure area over Persia and Baluchistan It is observed that the monsoon can never establish itself over India until the dry bulb temperatures over Arabia, Persia and Baluchistan are high, the maximum often exceeding 110 F As a matter of fact, this zone of high temperatures may even extend to the Caucasus in some years

The summer duststorms are often violent over the Persian gulf and the diurnal range of temperatures in Persia and Baluchistan region is also high Moreover, the trajectories of the surface and upper winds often provide a light following wind to the locusts As a matter of fact, the favourite paths of the locusts from Persia entering India and other countries are surprisingly similar to the wind fields in this region

In June, the locusts migrate from Persia which is a rainless area in summer, and settle down in India over a desert area *viz*, Rajputana where there are about three to four days of rain in a month yielding about 2" of rainfall

From October onwards, on the other hand anticyclonic vortices often appear over Rajputana and Gujerat These are known to cause markedly foggy conditions along the Sind Mekran coasts in the mornings The trajectories of the light upper winds in these vortices are north easterlies over Rajputana and south westerlies over Gujerat The trajectories therefore frequently provide following winds for short westward flights of locusts over the north Arabian Sea and then across the Mekran coast The emigration of the locusts from India in October should therefore be from Rajputana which dries up quickly after the rains to Persia where the rainy season commences

---

*This work was done while the author was an Assistant Meteorologist at Karachi in 1945-46 under the direction of Dr S. N Sen, the then Dy Director General of Observations (Fore casting), Indian Meteorological Department.

The single factor which appears to control the migration of locusts is seasonal desiccation the direction of flight of most of the swarms being determined by light following winds The migration cycle of locusts is thus closely correlated with the rainfall cycle between Rajputana and Iraq The cycle is explained by Table I It sets out the rainfall and rainy days at some of the Persian and Rajputana stations

TABLE I

NORMAL RAINFALL & RAINY DAYS (above 0 10") IN SOME SELECTED STATIONS OF IRAQ & RAJPUTANA BASED ON 4 YEARS DATA
i e 1934 1937

NORMAL RAINFALL

	Nov	Dec	Janu	Feb	March	April	May	June	July	August	Sept	Octo
IRAQ												
Hinaidi	1 07	1 47	1 09	1 19	0 13	0 58	0 59	0 01	0	0	0	0 13
Diwaniqa	0 53	1 26	0 75	1 29	0 21	0 72	1 62	0	0	0	0	0 13
Mosul	3 03	1 63	1 87	2 02	0 89	1 75	1 70	0	0	0	0	0 62
Rutbah	0 70	1 04	0 56	0 33	0 19	0 57	0 39	0	0	0	0	0 76
Shaibah	1 02	1 95	1 05	1 28	0 39	0 65	0 29	0	0	0 01	0	0
Muscat	0 13	0 73	2 74	1 02	0 56	0 06	0 02	0	0 02	0 01	0	0
RAJPUTANA STATIONS & KARACHI												
Jodhpur	0 38	0 23	0 10	0 34	0 03	0 17	0 05	2 07	3 58	3 11	2 24	0 09
Bikaner	0 13	0 22	0 07	0 53	0 36	0 28	0 10	1 38	4 18	4 57	1 11	0 03
Udaipur	0 23	0 11	0 16	0 17	0 09	0 06	0 03	2 03	6 29	2 85	5 66	0 13
Barmer	0 07	0 25	0 26	0 15	9 12	0 16	0 01	0 49	4 66	2 31	1 25	0 08
Karachi (Drigh Road)	0	0 34	0 30	0 78	0 02	0 52	0	1 11	4 11	4 11	0 15	0 01

NORMAL RAINY DAYS

	Nov	Dec	Janu	Feb	March	April	May	June	July	August	Sept	Octo
IRAQ												
Hinaidi	2 5	3 0	2 0	2 7	0 3	1 3	1 0	0	0	0	0	0 05
Diwaniya	1 5	3 3	2 5	2 5	0 7	0 5	0 7	0	0	0	0	0
Mosul	7 0	3 5	5 3	6 3	1 7	4 5	3 3	0	0	0	0	1 7
Rutbah	1 7	1 3	1 0	1 0	0 5	1 7	1 7	0	0	0	0	1 3
Shaibah	2 7	4 3	2 3	2 7	1 5	1 7	1 0	0	0	0	0	0
Muscat	0 [illegible]	1 7	2 3	1 5	1 3	0 3	0	0	0	0	0	0
RAJPUTANA STATIONS & KARACHI												
Jodhpur	0 5	0 3	0 3	0 7	0	0 5	0 3	3 0	6 3	5 0	4 3	0 3
Bikaner	0 3	1 0	0 3	0 5	0 7	0 5	0 3	2 0	5 3	5 5	1 7	0 3
Udaipur	0 5	0 5	0 3	0 5	0 3	0 3	0 3	6 0	9 0	5 0	8 0	0 5
Barmer	0 5	0 7	0 5	0 3	0 5	0 5	0	1 3	5 7	3 3	2 3	0 5
Karachi (Drigh Road)	0	0 5	0 5	1 5	0	0 7	0	1 7	4 3	0 3	0 7	0

It is seen from the Table that on the average Persia is practically rainless in the summer and Rajputana has little rainfall in the winter The averages of these elements over long periods fully confirm these features

The winter maximum of rainfall in Iraq (Persia) is associated with the eastward passage of western disturbances The summer maximum of rainfall in Rajputana on the other hand, is more or less associated with the westward passage of eastern (monsoon) depressions

It is clear from the preceding paragraphs that the cycle of locust migrations is from one desert region of maximum rainfall in the winter to another with its maximum rainfall in the summer These are the centres between which the cycle operates It is for the entomologists to consider whether about four to five rainy days in a month giving about two inches of rainfall may be said to furnish the Optimum' conditions for locust settlement and breeding It is a well known fact that there is close correlation between insect and humidity, and swarming is governed by reproductives under the influence of physical factors

The Meteorologist would like to know whether the locusts dislike dust storms and like fogs? Further do they try to avoid temperatures below [illegible]0°F and above 110°F on the average? There are airsacs in locusts which help in bouyancy and respiration during long flights through air Could there be no relation between densities of air inside the body and the surrounding air, to urge insect to move forward and while doing so, takes as a matter of fact the normal wind trajectories, from surface to about 3000 feet? Do they try to select a region with relative humidity the diurnal range of which is between 50 and 90% for breeding purposes? Can they stand a diurnal range of temperature exceeding 30°? Do they find sandy soil preferable to other types? These are a few of the questions the answers to which might stimulate research in the border line of Meteorology and Entomology

WILD MANGOES OF INDIA*

SUNILKUMAR MUKHERJEE
BOTANY DEPARTMENT DELHI UNIVERSITY

INTRODUCTION

THE mangoes (*Mangifera indica* L) are broadly grouped under two categories—(i) the *seedling races* (both wild and cultivated) and (ii) the *horticultural varieties* propagated by budding or grafting (Popenoe 1932) The *seedling races* cultivated or wild are not so well known in India as the mangoes of this country are obtained mostly from grafted varieties which grow successfully over large tracts of Bombay Madras Bengal Bihar and United Provinces A fair knowledge about these types is available in the surveys of the varieties in Bombay (Burns and Prayag 1921) Madras (Naik 1941) Bihar and U P (Woodhouse 1909) and Bengal (Mukherjee 1948) On the other hand the knowledge on the wild types consists mainly in the reports of their occurrence in different areas no detailed information regarding their fruits being available Wild forms of *M indica* (mango) which are closely allied to the cultivated grafted types are reported to occur in the tropical and lower mixed forests of Burma and the Andamans (Kurz 1877) in the evergreen forests of Khasi Hills and the valleys of Assam (Kanjilal Das and Purakayastha 1947) in Sikkim (Hooker 1876) in the sub himalayan tract in deep gorges of the Baraitch and Gonda hills in Oudh in the outer hills of Kumaon and Garhwal in the higher hills of the Satpura range and along the Western Ghats in South India (Brandis 1864))

As information about the wild types is necessary for utilizing them in any programme for breeding of this fruit tree an exploration was undertaken in the Khasi Hills Chittagong Hill Tracts Kalahandi (Eastern States Agency in Orissa) and Chota Nagpur to discover the types of wild mangoes occurring in those areas an enumeration of which is made in the present paper

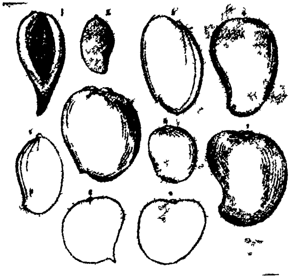
DESCRIPTION OF THE WILD TYPES

The genus *Mangifera* L contains 41 species distributed from India to the Philippines and New Guinea through Malay Peninsula and the Archipelago Among these only 3 species occur in India (Mukherjee 1949a)

Of the Indian species *M khasiana* Pierre is of doubtful occurrence as it has not been recently found in Assam wherefrom the type specimen was collected The other two species are *M sylvatica* Roxb and *M indica* L (the common mango) which are very much allied A description of the wild races of both of these Indian species are given below

M sylvatica Roxb a species occurring only in N E India (Assam and Chittagong Hill Tracts) by the side of ravines and small *nullahs* in the hill gorges up to an elevation of 3 000 ft is a very tall tree attaining a height of about 150 ft with a straight trunk 25 30 ft in circumference at base The leaves are long and broad like some of the long leaved mangoes but the petiole is much elongated (3 4 inches) The inflorescence is of the same type as the mango (*M indica*) with similar pentamerous flowers having only 1 fertile stamen but completely glabrous

The fruits are very characteristic (Fig 1) elliptic in shape with a pointed acuminate apex not found in any other species greenish yellow when ripe with a smooth thick epicarp much thicker towards apex flesh thin slimy almost free from fibres and with a fine aroma



Figs 1 10 showing fruits of wild mangoes (Reduced to ¼th of the original drawing)

1 *M sylvatica* 10 *M indica* (wild races) 2 *Chittagong Hill Tract type* 3 10 *Kalahandi types* 3 *Type I* 4 *Type II* 5 *Type III* 6 *Type IV* 7 *Type V* 8 *Type VII* 9 *Type VI* 10 *Type VIII*

The fruits of the species collected from three localities differ in size the Mikir Hill type (at 1 000 ft) has the largest fruit (10 cm ×6 cm) the Khasi Hill type (at 2 500 ft)has the smallest fruit (8 cm ×3 5 cm) and the Chittagong type(at 1 000 ft) has fruits of intermediate size The Khasi Hill type flowers during September October and produces fruits during December —January whereas the other two types produce fruits during March April This species may improve by breeding and culture as the flesh of the fruits is almost free from fibres and gives out a fine aroma when ripe The fruits are reported to be edible and are used for pickles

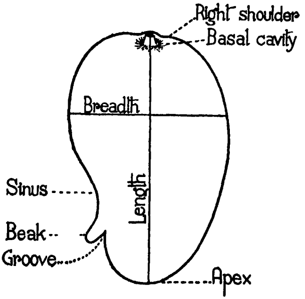
---

*The work has been conducted with the financial assistance of Indian Council of Agricultural Research at the Botanical Laboratory of Calcutta University

M indica Linn , has similar tree habit as the former species, and occurs mostly in the evergreen forests at an elevation up to 3,000 ft in the gorges of the hills or by the sides of ravines and *nullahs* The leaves are similar to *M sylvatica*, with long petioles unlike the cultivated types The inflorescence and the flowers are similar except being pubescent The fruits are different from those of *M sylvatica*, and are like the cultivated varieties in shape, but of smaller size They are described below

1 *Chittagong Hill Tract type*, collected from the forests, 20 miles from Rangamati, the headquarters of the Tract where it is very common

The fruits (Fig 2) are oblong, small, 5×2 75×2 5 cm in size, golden yellow when ripe , basal cavity absent, shoulders short and equally falling , beak imperceptible, skin thick with short close glands, flesh scanty, adhering to the innumerable fine, soft fibres, juicy and very acidic, with an agreeable flavour , stone almost wholly filling up the fruit



Diagrammatic drawing of a fruit showing the various parts

2 *Kalahandi types*, collected from the Thuamul Rampur Forests of the state, about 40 miles from its capital Bhawanipatna It belongs to the Eastern States Agency of Orissa Eight different types of fruits have been collected, details of which are given below .

Type I Fruits are 9×6×5 cm in size, elliptic oblong in shape , basal cavity absent , shoulders smooth, left higher, right sharply falling , beak slight, pointed, 2 cm below narrowed apex (Fig 3) , flesh thick but traversed with fibres

Type II Fruits 9×6×5 cm in size, ovate-oblong in shape, basal cavity absent, shoulders almost level, beak very slight 2 cm below round apex (Fig 4) , flesh thick but traversed with fibres

Type III Fruits 7×4×4 cm in size, elliptic-oblong in shape, base protruded, shoulders equally falling , beak slight, almost imperceptible , sinus shallow below the beak (Fig 5)

Type IV Fruits quite big and plump, 8×6 5×6 cm in size, elliptic in shape, basal cavity slight, shoulders equally falling but prominently ridged , beak prominent, broad, pointed upwards, 2 5 cm below apex , glands prominent on skin , flesh thick but traversed with fibres (Fig 6)

Type V Fruits as big as some good cultivated grafted varieties, 9×7×6 cm elliptic oblong in shape , basal cavity deep , left shoulder broader , beak almost imperceptible , sinus prominent below the beak , flesh thick but traversed by fibres (Fig 7)

Type VI Fruits 6 3×6×5 2 cm in size, roundish in shape , basal cavity slight, shoulders almost level, left broader , beak slight, almost imperceptible , apex round (Fig 9)

Type VII Fruits 5 5×5 2×4 4 cm in size, roundish in shape, basal cavity absent , shoulders level, left slightly broader , beak very prominent , protruded side ways from apex (Fig 8)

Type VIII Fruits 5 3×4 6×3 6 cm in size, ovate-oblong in shape , basal cavity absent , shoulders level, equally falling, beak very slight, almost imperceptible, 2 cm below round apex , flesh thin, fibrous (Fig 10)

CONCLUSION

The two species, *M sylvatica* Roxb and *M indica* L occurring in India, are very much allied in their morphological characters differing mainly in the fruits The leaves of the 'wild types of *M indica* show tendencies towards formation of large leaves with long petioles, as are found in the wild species, *M sylvatica* , but in the cultivated varieties of mango the petioles are much shorter This similarity suggests that *M sylvatica* has played some part in the evolution of *M indica*, wild types of which are very common in the areas of NE India where the former species occurs Moreover the chromosome number for both the species is same, $2n-40$ and $n=20$ (Mukherjee, 1949b) The anatomical studies has not indicated much difference between the three species *M indica*, *M caloneura* and *M sylvatica* (Mukherjee, 1949 c) An analysis of the pollen grains also shows that they have grains of almost similar size and shape (Mukherjee, 1949d) All these evidences suggest that interspecific crosses between these two species may easily occur, as the flowering season in some of the *M sylvatica* types merges with that of the mango, and hybridization in nature has therefore played an important part in the evolution of the mangoes

The different fruit types reported in this paper show that the wild mangoes also possess a variety of shapes as are found in the cultivated varieties. Moreover in the forest areas where suitable conditions for their growth are available, they attain almost the same size (*Types II, IV and V*), as the good cultivated varieties The cultivated horticultural varieties of mango have been classified by Woodhouse (1909), Burns and Prayag (1921) and Popenoe (1911) on the basis of fruit characters Mukherjee (1948) has recently classified them into 3 groups—*Round*—, *Ovate oblong*— and *Long—fruited* on the basis of fruit shapes and delimited the different varieties by the presence or absence of beak, sinus, basal cavity etc The types enumerated in this paper show that these different fruit-shapes are also represented in the wild races, along with the different characteristics of beak basal cavity ridges on the shoulder etc It appears therefore that selection by man has played an important role in the production of these cultivated varieties from the various wild types growing in India

SUMMARY

An exploration into the forests of Assam Chittagong Hill Tracts (near Burma border) Kalahandi State (Eastern States Agency, Orissa) and Chota Nagpur has led to the discovery of the three types of fruits of *M sylvatica* and 9 types of *M indica* The fruits of the wild mango are of various shapes as are found in the cultivated varieties and sometimes attain the same size as the latter types It is indicated that selection by man played an important role in the production of cultivated mangoes

M sylvatica and *M indica* are very much allied in morphological features, with the same flowering time in some types As they occur in the same area and have the same chromosome number and similar anatomical features and pollen morphology it appears quite likely that hybridization in nature between the two species has played an important role in the evolution of the mangoes*

LITERATURE CITED

Brandis, D The Forest Flora of N W & C India, 126, 1864
Burns, W & Prayag S H The Book of the Mango Bull No 103, Dept Agric Bombay, 1921
Hooker, J D Flora of British India ii 13 20 1876
Kanjilal U N , Das, A and Purakayastha, The Flora of Assam, i, 336, 1937
Kurz, S Forest Flora of British Burma i 303 305, 1877
Mukherjee, S K The varieties of mango (*Mangifera Indica* L) and their classification *Bull Bot Soc Bengal 2* 101 133, 1948
– ———A Monograph on the genus *Mangifera* L *Lloydia, 12*, 73 136, 1949a
——— —Cytological Investigation on Mango (*Mangifera indica* L) and the allied Indian species (*in press*) 1949b
————Anatomical studies on some species of *Mangifera* in relation to Taxonomy *Journ Ind Bot Soc 28* 162 171, 1949c
— ——Pollen Analysis in *Mangifera* in relation to Fruit set and Taxonomy (*in press*) 1949d
Naik K C South Indian Mangoes Bull No 24, Agric Dept Madras, 1941
Popenoe, W *Pomona Coll Jour Econ Bot* December Issue, 1911
—— Manual of Tropical and subtropical Fruits, 79 145 (MacMillan & Co) 1932
Woodhouse E J The Mangoes of Bhagalpur *Quart Jour Dept Agric Bengal ii*, No 3 168 187, 1909

---

*I am grateful to Prof S P Agharkar Director Maharastra Association for the Cultivation of Science Poona for his keen interest and encouragement in the work Thanks are also due to the various Forest Department Officials for help in collection of the wild mangoes

---

EDUCATION IN GERMANY WITH SPECIAL REFERENCE TO THE SYSTEM OF CHEMICAL EDUCATION

HARA GOPAL BISWAS,

SIR PRAFULLA CHANDRA RESEARCH LABORATORY, BENGAL CHEMICAL, CALCUTTA

WHEN we come to look at the list of Nobel Prize winners in chemistry we are surprised to find that among the 40 recipients of the prize from the year 1901 to 1939, 15 are German and 3 are Swiss I mention the number of the Swiss winners as the method of instruction in Swiss educational centres is of the same type as in the German scientific institutions That almost half the Nobel Prizes in chemistry should go to practically one country cannot be attributed to mere chance nor can it be attributed to climatic effect or racial superiority of the people There must be some fundamental causative factor for the remarkable efficiency of the Germans in the field of chemical science The secret of success of the German people lies in the very high standard of their method of instruction inaugurated by men of genius like, Liebig Hofmann, Kekulé, Baeyer Emil Fischer and others, and steadfastly maintained in the foremost chemical institutions of the country

Now I should like briefly to describe here the educational system in Germany, laying special stress on the instruction in chemistry that obtains in the German scientific institutions.

In Germany education of children begins in the primary schools or 'Volkschule' In the 4 year course children from the age of 6 to 10 learn reading writing, simple calculation, domestic science and religion

Next they join high schools Oberschule' or 'Gymnasium' In Switzerland these schools are known as 'Mittelschule' or middle schools which offer 6 year course for students of the age from 13 to 19 years The Gymnasium provides 9 year course in which pupils from 10 to 19 years of age learn Latin French, English, German, sometimes Greek, including literature Mathematical course consists of arithmetic algebra, geometry, trigonometry, arithmetical and geometrical progressions, fundamental principles of spherical trigonometry as well as differential and integral calculus Biology and chemistry are also included in the course Chemistry is divided into general inorganic chemistry, fundamental conceptions of organic and physical chemistry Principal topics to inorganic and physical chemistry are chemistry of water, of lime and mortar, carbon dioxide and a few other well known metals and non-metals, stoichiometric fundamental conceptions, ionic reactions, introduction to the modern conceptions on the structure of atoms as well as co valent and electro valent combinations Introduction to organic chemistry includes fermentation catalysis, hydrocarbons alcohols, organic acids, esters carbohydrates, di and polysacchari des and proteins The practical course consists of simple inorganic analyses, esterification nitration, saponification, etc The course of physics includes mechanics, optics acoustics and electricity There are theoretical and practical exercises in chemistry and physics Besides one has to study general and eco nomic geography of all countries history of German and other European countries religion and history of the Church, artistic and technical drawings, history of fine arts, music and gymnastics including sports The student has to appear in the oral and written exami nations in these subjects This school final examina tion is a strict one and is called 'Reife Prufung" "Maturum' or Abitur' The written examinations are organized by the Ministry of Education and the oral examinations take place in the presence of the ministerial staff After passing his Abitur the student is entitled to higher studies either in the University, in the technical Hochschule or in the Akademie An Akademie generally imparts training in fine Arts and Music

In the University there are the following faculties

(1) Philosophical Faculty and Faculty of Natural Sciences
(2) Medical Faculty
(3) Legal Faculty, and
(4) Theological Faculty

The Philosophical Faculty deals with German English Sanskrit and other languages and literature as well as history, philosophy, etc The Faculty of Natural Sciences on the other hand is divided into chemistry, physics, mathematics geology, zo logy, botany, etc

The Technische Hochschule is composed of two faculties

(a) Faculty for Applied Sciences (b) Faculty for Pure Sciences

The following subjects fall under the former cate gory

(1) Construction of Machine and Apparatus
(2) Electrotechnique,
(3) Building Engineering
(4) Land Survey etc,
(5) Agriculture, and
(6) Fermentation and Brewery

To the Faculty of Pure Sciences belong

(1) Chemistry, (2) Physics, (3) Botany, (4) Geology, Minerology, and Mathematics

The scientific subjects (1, 2 3, 4) taught in the Hochschule are mainly of the applied type The out look of the Hochschule is oriented to a practical point iew The University on the other hand cherishes ancement of fundamental science

The president of a Faculty is known as "Dekan" and the president of a Hochschule or a University is called a "Rektor"

The system of education adopted in the University is descrbed in brief below

University study leads to the degrees of Dr Phil II or Dr Chem The principal subject may be any one of the natural sciences We should here concentrate our attention to the course of studies required for Dr Phil in chemistry The frame work of the study consists of practical work

(*a*) Analytical Chemistry Carrying out of a cer tain number of inorganic qualitative analysis metals, anions technical analyses, the alloys When the student has performed satisfactorily the prescribed number of analyses and experimental work he is allowed to under take quantitative analytical practical work Here also he must carry out a fixed number of gravimetric, colori metric titrimetric and potentiometric estimations On successful completion of all these (duration 2 to 4 semesters) the student must appear at the theoretical oral examination in analytical chemistry (individual examination lasting for 30 minutes) If he passes these examinations he is allowed to take up preparations of organic compounds

(*b*) The student has to prepare here 10 inorganic and 34 organic preparations and further he has to syn thesize 5 dyestuffs and correctly to solve 5 organic analyses If he performs this course satisfactorily in 3 to 4 semesters he must appear at an examination in organic practical chemistry (Methods aliphatic, aromatic, and heterocyclic chemistry in fundamentals Individual examination oral, lasting for 30 minutes) When he has passed this course he must take during the vacation a three week s course in microanalysis He must learn the handling of microbalance as well as the micro determination of CH N OCH_3 active hydrogen acetyl C methyl and so forth If he has satisfactorily gone through this course he is entitled to take up his doctorate work which generally takes 4 to 5 semesters time This consists of an independent research work under the guidance of corresponding Dozent

Besides this practical frame work, side examina tions in other branches are also required Along with his attendance in the general and special lectures in chemistry the student must also occupy himself with other branches of natural science Before doctorate examination the student has to go through 3 examina tions in other branches and this must not be before 5 years of his doctor examination For a student of chemistry, mathematics and physics are compulsory Besides he is to take one of the following subjects—mineralogy, geology, physiology, zoology and botany. All examinations are oral—each test lasting for 30 minutes Mark below 40% are not counted Marks above 60% are considered as marks of distinction When a candidate has passed all these examinations (when one of them is not sufficient he can repeat it once more), he is entitled to present his dissertation. If the dissertation is approved by the Faculty he must be prepared for the final examination within 6 months For a student of organic chemistry this examination consists of physical chemistry, oral 30 minutes, organic chemistry, written 4 hours and oral 1 to 2 hours A candidate desirous of doctorate in physical chemistry has naturally to take a short course in organic chemistry

In the University, before doctorate degree generally no diploma is given In some German Universities however, the student has to pass diploma examination (8 semester course) to qualify himself to take the doctorate course When the performance of a student has been specially good (all examinations with marks above 60%, and dissertation also very good) it may be mentioned in his diploma (distinction) but no addition is made to his title After his doctorate degree a student acquires no other distinction or degree

As the first step to academic career he must be associated with a professor as Dozent This stage is known as Habilitation Period He must now publish a series of good work and conduct a long habilitation work and submit an inaugural dissertation The corresponding Faculty decides the acceptance of this dissertation or Habilitationsschirft The student is now eligible for academic facilities, and is entitled to give lectures as a recognized Privatdozent at the University He is not yet a professor but if there is any vacancy he may be nominated or appointed to the post of a professor In the teaching line in the University or Hochschule the following grades of service exist

(*a*) Privat Dozent,
(*b*) Ausserordentlicher Professor,
(*c*) Ordentlicher Professor

Technische Hochschule offers facility for the diploma of Chemical Engineer in 7 years Here the annual courses are strictly and properly organized After two years' study the student must appear at the first preliminary diploma examination in four subjects conducted orally After another 2 years he is to sit for the second preliminary diploma examination This is also conducted orally, but in a number of subjects The student has then to undertake a short diploma work which is naturally of much lower standard than the doctorate work When this is completed he appears at the final diploma examination consisting of both oral and written papers The diploma of the Hochschule (as of the Eidgenossischen Technischen Hochschule of Zürich) is a highly prized one After getting his diploma an ambitious student can devote another 2 years or so for doctorate work there For this he is to submit a thesis and to sit for the doctorate examinations—oral and written Dr ing, Chem or D Sc of the Hochschule and Dr Phil II of the University are absolutely equivalent degrees

In addition to the prescribed courses mentioned above, a 'Doktorand' (candidate for doctor degree) must read a few papers on some notable chemical problem of the day in a colloquium, where all the 'Doktorande', 'Dozenten' and professors of the allied subjects of the institution assemble together,

The higher students have also got opportunity to attend lectures in the chemical society arranged once every week

We have already noticed the difference between the function of the University chemical institutes and Technische Hochschule There is however another category of institutions which are mainly concerned with technical training In Switzerland there are two such institutions—one at Winterthur and the other at Burgdorf No Middle School attendance or school-leaving certificate is necessary for admission into these institutions They impart purely technical training in different subjects to youngsters The course of instruction varies from 2 to 4 years

Besides the technical training received at such a 'Technikum , a young man may avail himself of the facility to qualify himself as a Laborant (laboratory assistant) To attain this end the candidate must be associated with an eminent chemist (a professor or a research chemist) for a 3 year course After this apprentice training period he must pass the prescribed tests to become a recognized Laborant

It is needless to mention that people trained in this way add greatly to the efficiency of the academic or industrial laboratories of the country

The system of chemical education in the Swiss University institutions and Hochschule is practically the same as in the corresponding German institutions In both the countries after the Doktor Diplom no further academic recognition exists

As it is almost impossible at the present time to visit German chemical institutions on account of political restrictions the Indian students would do well if they visit Swiss chemical institutions But the students must acquire a working knowledge of German before they start for Switzerland The minimum expenses for board and lodging at Zurich amount to about 225 to 250 Swiss Franks (Rs 100 85 S F) The student has again to spend additional 50 to 75 Franks for tuition fee and the cost of the chemicals and apparatus he has to use per month

While describing curriculum I have used the term semester Their academic year is divided into two semesters— summer and winter semesters The research is organized on the pattern of a routine manufacture One can traverse step by step without any loss of time Standard equipments like high vacuum pumps hydrogenation and ozonization apparatus, equipments for microanalysis the ultraviolet spectrograph spectrophotometer microhydrogenation apparatus pressure hydrogenation apparatus, thermostat etc are always ready at hand The expert pharmacologist is also not wanting in this picture A new chemical compound is prepared today and by to morrow evening all the relevant physical and chemical constants of the compound are ready at the worker's desk Unless such facilities are forthcoming no progress worth the name can be expected in any branch of practical science today

The library facilities are equally great and commendable Any recent journal or book and any old reference book including patent literature of every land are within easy reach of every student

This brief account is written in the hope that the gifted persons at the helm of our educational affairs will come forward to remodel the existing system of chemical education in a way which will facilitate positive progress long overdue in this most important branch of natural science upon which rests the well being and prosperity of our newly awakened nation We are quite confident that given proper facilities and efficient organization of our institutions for higher chemical studies and research, the present and coming generation of our chemistry students will not fail to give a good account of themselves and will significantly contribute to the advancement of chemical science in the country *

---

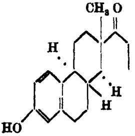
*In fine I should like to express my deep sense of gratitude to Dr Robert Schwyzer privat dozent to Professor Paul Karrer, to Dr H Oeppinger of the I G Farbenindustrie, Hoechst, and to Dr C Schuster of the Badiche Anilin und Sodafabrik, Ludwigshafen, Germany for the help they extended to me in this connection

TOTAL SYNTHESIS OF ESTRONE AND ITS ISOMERS*

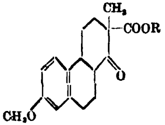
D K BANERJEE

COLLEGE OF ENGINEERING & TECHNOLOGY, JADAVPUR

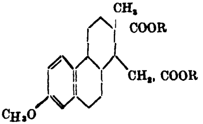
THE first total synthesis of the naturally occurring sex hormone estrone (I) was achieved by Anner and Miescher[1] in 1948 The programme of this synthesis which was finally made successful by the Swiss workers, was initiated by Robinson and coworkers[2] as early as 1935 and considerable progress was recorded in 1938, when the conversion of the key compound keto ester (II) to the diacid (III) was reported[3]



I



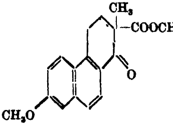
II



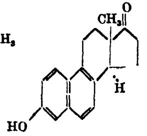
III

R= —H or — C_2H_5

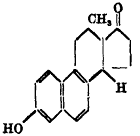
In 1940 Bachmann, Cole and Wilds[4] in America announced the first total synthesis of a naturally occurring sex hormone equilenin † This classical piece of work can be considered as a triumph of technique in the synthetic organic chemistry In this synthesis keto ester (IV) was converted into *d*, l equilenin (V) and *d*, l isoequilenin (VI) through a series of steps, all of which were attended with very high percentage of yield Following the same sequence Bachmann, Kushner



IV



V



VI

and Stevenson[6] in 1942 succeeded in synthesizing a stereoisomer of estrone, 'estrone a" from the keto ester (II), which was prepared by a method somewhat different from that of Robinson *et al* In their successful synthesis of natural estrone Anner and Miescher have used essentially the same scheme as Bachmann *et al*, but they have exhibited exceptional skill and thoroughness in isolating three out of four possible racemic isomers of II Conversion of all these isomers into six of eight possible racemic forms of estrone, estrone *a-f*, have now been reported[7] This includes natural estrone, estrone *b*

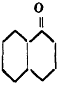
Very recently a completely new synthesis of natural estrone and remaining stereoisomers *g* and *h* has been reported by Johnson, Banerjee, Schneider and Gutsche[8] Investigation on this synthesis started with the successful conversion of α-decalone (VII) to *trans* 8 methyl-hydrindanone-1 (VIII) by Johnson[9]

---

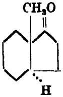
*Based on a lecture delivered at the Indian Association for the Cultivation of Science

† Since then two different syntheses of equilenin have been reported by Johnson and coworkers.[5]

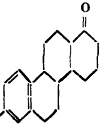
This model experiment was carried out with a view to applying similar reactions to the terracyclic ketone (IX) for its conversion into estrone molecule Starting materials for the preparation of IX are m hydroxyacetophenone (X) and 1, 5 dihydroxynaphthalene (XI), both of which are easily available cheap products X and XI were respectively converted into *m* methoxyphenylacetylene (XII) and 1, 5 decalindione (XIII) Latter two compounds were condensed, reduced and dehydrated to give the unsaturated ketone (XIV) in 70% overall yield Cyclisation of XIV was carried out with hydrogen chloride and aluminium chloride in benzene solution and an oily mixture was isolated from which were crystallized in about equal amounts two stereoisomers of IX Both these isomers were converted into corresponding benzal derivatives which were methylated to yield four different angularly methylated stereoisomers in conformity with the previous observation during the model experiment on *α* decalone All these methylated benzal derivatives were oxidized with ozone to corresponding *d,* 1 homomarrianolic acid methyl ethers Latter dibasic acids on ring closure and demethylation yielded estrone *b* (natural estrone), estrone *d* (previously isolated by Miescher) and new isomers estrone *g* and *h*



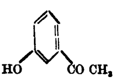
VII



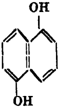
VIII



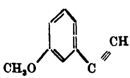
IX



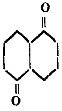
X



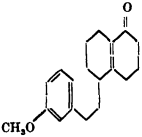
XI



XII



XIII



XIV

Total synthesis of all possible stereoisomers of the estrone molecule may be regarded as unique achievement in the history of organic chemistry and will provide immense impetus in future for the synthesis of more complicated molecules in the steroid field

REFERENCES

[1] Anner and Miescher, *Experientia 4,* 25, 1948, *Helv Chim Acta, 31,* 2173, 1948

[2] Robinson and Schettler, *J Chem Soc*, 1288 1935

[3] Robinson and Walker, *ibid*, 183 1938

[4] Bachmann, Cole and Wilds, *J Am Chem Soc*, *62* 824 1940

[5] Johnson Peterson and Gutsche, *ibid 69* 2942, 1947 Johnson and Stromberg, *ibid*, *72* 505 1950

[6] Bachmann, Kushner and Stevenson *ibid*, *64* 974, 1942

[7] Anner and Miescher, *Helv Chim Acta 32*, 1957, 1949

[8] Johnson, Banerjee Schneider and Gutsche, *J Am Chem Soc*, *72* 1426 1950

[9] Johnson, *ibid*, *65* 1317 1943 *ibid 66*, 215, 1944

ATOMENERGIE AND ATOMBOMBE *

EINSTEIN wrote a letter to President Roosevelt on August 2, 1939, outlining some of the potentialities of atomic energy including the atomic bomb There was an initial grant of 6,000 dollars for beginning the work and it reached the final total of two billion dollars for making the bomb Since 1940 the United States Government has invested 4 5 billion dollars in this project, a sum which exceeds the total national debt since 1918 This does not include the cost of the projected hydrogen bomb

On December 2, 1942, the first controlled atomic pile started working at the University of Chicago On 16th July, 1945, the first atomic explosion took place in the deserts of New Mexico under the supervision of Dr J R Oppenheimer, who as a student of the *Bhagwad Gita* (he read Sanskrit with Aurthur Ryder, whose delightful translation of the *Panchtantra* is available in a cheap edition) was reminded of the *shloka* in the 11th chapter mentioning the splendour of a thousand suns This test practically demonstrated the possibility of a chain reaction for atomic explosion when fissionable material exceeded a certain critical mass

---

*By Dr Friedrich Dessauer, Professor of Physics, in the University of Freiburg, Switzerland, (2nd enlarged edition, 342 pages, published by Verlag Otto Walter Ag Olten ; in German)

On August 6, 1945, the first atomic bomb (uranium 235) was dropped on Hiroshima Two days later a plutonium bomb fell on Nagasaki This was followed by two atomic explosions in peace time for the Bikini tests

Plutonium was first produced in U S A from an atomic pile in January, 1944, and a start was made with only half a milligram to study its chemistry As a result of it the Hanford plant came into operation for the production of plutonium It also occurs, as has recently been revealed, natrually in traces with uranium, but is not available in sufficient quantities to dispense with its preparation from an atomic pile

The book appeared in its 2nd edition as a result of the great interest aroused by atomic energy and atomic bomb, and was published simultaneously in a French translation at Neuchatel It deals with the developments up to the Bikini tests or the 5th atomic explosion, and does not envisage the development of the thermal nuclear bomb, the so called superbomb or the hydrogen bomb which requires an atomic explosion to furnish the high temperature of about 20 million degrees for synthesizing helium from ordinary or heavy hydrogen provided in the elementary stage or from lithium hydride On the contrary, the author holds that it is "certainly without prospect" (page 89) that it should be possible to form helium from neutrons and protons with the energy levels obtainable on earth The book needs third edition to be topical and to catch up with the long strides made by science since it appeared last, and also stands in need of a further revision as it has here and there sentences without verbs and some misprints, as on page 7 in the foreward to the 2nd edition 'Muge' is printed in place of 'Muhe', on page 40 'provod' is spelt 'prooved', on page 132 it is wrongly stated that ordinates show isotopes, on page 190 at the bottom in place of 'm_2-m_1 is printed m_2-m_2, on page 196 in discussing the critical mass for starting a chain reaction is printed $\frac{‘r3’}{\gamma 2}$ in place of $\frac{‘r^3’}{r^2}$, on page 248 in place of uranium (238) is printed uranium (236), on page 269 'v' is omitted from $20V_2^2$, on page 303 'particles' is spelt 'particels', in the Index graphite as moderator is referred to page 186 wrongly in place of page 157, Fermi is spelt Faemi, J J Thomson is spelt Tompson but on page 274 as Thompson Lise Meitner is sometimes spelt Liese Meitner in the book Hitler is quoted in the text (page 320 321) but the author has consigned him to oblivion by omitting him from the index where Mr Winston Churchill is mentioned It is not revealed if it is because Mr Winston Churchill is a Fellow of the Royal Society

As stated in the foreword, only elementary mathematics is used in the book and no more knowledge of physics is assumed on the part of the reader than is available to a student of physics early in college The book consists of 12 chapters and is generally very readable In the first eight chapters, it gives an easy background for understanding the production of atomic energy It treats in an interesting manner such subjects as cosmic ray radiation, electro-magnetic waves, inter connection between matter and energy, protons, neutrons, materialization of energy, elementary particles, Einstein's Law Equivalence, particle reactions and nuclear reactions etc It has instructive tables, figures and graphs At the head of chapters it has neat pen drawings of scientists, and there are also some photographs in the book The place of honour is rightly given to a portrait of Professor Otto Hahn at the beginning of the book, but just behind it is the photograph of an anonymous scientist standing near a 7mev beam of protons from a cyclotron in Rochester, U S A One wonders who he is and has to read 290 pages to discover that the young man remarkable for a luxuriant growth of hair on his head is the author's son Like the usual run of Swiss publications the get up and type of the book are good, and make one wonder when Indian printers and publishers would attain this standard of book making for ordinary publications

The author touches upon the question about why the Germans lagged behind in manufacture of the atomic bomb (pages 153 154, and 320 321) The allies had in the continent of America a land without a black-out and without bombing Their laboratories were not destroyed or damaged by aerial bombing, as repeatedly happened at Peenemunde Their transport was not destroyed or damaged There was no scarcity of essential raw materials Besides, the Nazis persecuted their top ranking scientists who were not Aryans Hitler stated early in his career, when a scientist protested to him against this kind of persecution, that Germany could do without Physicists for a few years Einstein went to America Lise Meitner, a collaborator of Dr Otto Hahn left Germany Prof Hans A Bethe left Tubingen for the U S A where he later worked on the atomic bomb project at Los Alamos Prof Fermi left Italy for the United States, and Prof Niels Bohr left occupied Denmark for the United States and, like so many others, helped in making the atomic bomb Other scientists who were in Europe were unwilling to put such a terrible weapon in the hands of the Nazis and very few of the eminent German scientists were Nazis The author wisely leaves this question for those concerned to answer

The last chapter has the title "Reflections, Fundamental Questions, Questions of Life, and Question for Humanity" The reflections are not deep and in fundamental questions of philosophy the author is naive and says

"The natural laws that the research worker finds and expresses are more than mental concepts (Gedankendinge) For if they were only these, and if in the laws and equations there were not truly contained a representation of the reality of nature, how could it be that our machines in fact produce what they are meant to produce, that medicines heal, soothe pain, bring sleep, that our fields produce fruit four and five fold, that aeroplanes fly, that electric light brightens our nights, and that, it must be mentioned, the new weapons kill and destroy so frightfully? Is the atomic bomb real? If it is not, but is only a mental concept, why are the Japanese towns destroyed? If it is real then this reality is born of intelligent thought and thinking beings, and the power that resides in them is not of men but the discovered power of nature" (Pages 317 318)

It is to be noted that real and reality have been used with different connotations indiscriminately The author seems to be unconcerned about analysis of perception and of phenomenon of the methods and limitations of knowledge, and the views on such subjects of Einstein and Planck, Hume and Kant, Eddington and Jeans, not to mention a host of others They cannot adequately be discussed in a review of this book but suffice it to say that they make no such claim for *science and scientific laws and hypotheses* When more than one hypothesis or equation can cover the same facts it is a tall claim that reality is confined in any one of the conceptual representations One need not be a *vedantist* to realize that sense perception imagination and reason, that is science, can never know the universe as it really is Such fundamental questions are best left for epistemology and metaphysics It should be apparent to any student of the above quoted paragraph of the author that the destroyed Japanese towns were as much mental concepts (or reality) as the atomic bombs that fell on them, and the same applies to the machines and the goods they produce as to the medicines and the aeroplanes

On page 325 the author goes religious and says that all scientific advance is the Revelation of Reality by the Creator on communion This kind of cheap claptrap and frothy mysticism is best left out of a scientific book

The author does not mention even casually the question of scientific freedom that is agitating so much the research workers and is making them resentful of State control and glice surveillance It is also hindering scientific advance as science cannot thrive in a stifling atmosphere that denies freedom of association and discussion to the workers

V P Chandra Gautama

Notes and News

NADI BIJNAN MANDIR

Dr B C Roy, Chief Minister of West Bengal, laid the foundation stone of the central laboratory of the River Research Institute (*Nadi Bijnan Mandir*) at Haringhata on the Ganges, about 32 miles from Calcutta, on May 21 last before a distinguished gathering of scientists, experts, engineers and Ministers of State Sri Bhupati Mazumder, Minister, Irrigation and Waterways presided

Laying the foundation of the Institute, Dr Roy recalled that a few years back, the people of Calcutta were alarmed at the news that the Bidyadhari River, which used to carry the refuse of the city, was silting up People in Bengal had then little knowledge of rivers and finally, the Calcutta Corporation had to reorganize the sewage system Subsequently the river dried up The maritime Port of Calcutta is at present not in a happy position because of the rising silt and sand deposits The Port Commissioners are thinking of a ship canal from Diamond Harbour to Kidderpore docks.

A number of swamps, the Chief Minister added had been formed in West Bengal affecting the health of the people and to remedy this, resuscitation of Bengal s drying rivers is essential The laboratory of the River Research Institute was now opened to help revival of these rivers.

Dr Roy expressed the hope that the various river projects in India as also in other countries of the world would be benefitted by the results of research in this laboratory

The Institute which was opened in 1943, has carried out studies with models of different river projects in India and of many contemplated railway bridges Following its findings, many changes have been made in the designs of various dams and barrages

Speaking on the occasion Dr N K Bose, Director, River Research Institute, West Bengal said that after the partition of Bengal the Bhagirathi occupied the most important place among the rivers that had fallen in the State In the olden days the Bhagirathi was one of the main courses of the Ganga A number of prosperous towns had grown up on its banks such as Berhampur, Ajimganj, Nawadwip Katwa, Hooghly With the diversion of the Ganga from Bhagirathi course, the importance and prosperity of these towns also decayed

During the British rule, said Dr Bose, industrial centre grew up round about Calcutta Ships full of merchandise sailed into the port up the Hooghly and delivered them at the docks From there these merchandise spread over the whole of north, west and east of India and also beyond its borders into Nepal and Tibet The importance and prosperity of Calcutta and for the matter of that, of the whole of West Bengal now depended principally on the Bhagirathi and its estuary the Hooghly

The Bhagirathi has been gradually drying out It is now extremely difficult to keep this estuary in a living condition It may be possible by artificial means to keep the Hooghly going for a few years but the expenses would be high and its repercussion on the health of the surrounding country would be difficult to foretell Flowing rivers keep the countryside full of health, wealth and prosperity whereas artificial means may keep the estuary living but cannot maintain the health of the country

Explaining the problems of the rivers that were facing the State, Dr Bose said that to study and solve them on the same lines as were done in the West the idea of establishing the River Physics Laboratory in Bengal was first expressed by Dr Meghnad Saha in Sir P C Roy Commemoration Volume in 1932 and Sri S C Majumdar in the National Institute of Sciences of India symposium lecture on river problems in Bengal

The selection of the site at Haringhata was due to the fact that it had the great advantage of an unlimited supply of clear water and cheap electricity An area of 320 acres had been set apart for the Institute

VETERINARY RESEARCH AND ANIMAL HUSBANDRY

The tenth All India Veterinary Conference was held at Bombay from April 25 27, 1950 Dr S Datta, Director Indian Veterinary Research Institute, Mukteswar Izatnagar presided In his presidential address Dr Datta made an earnest appeal to all veterinarians to vitalize the activities of the profession and emphasized the essential unity underlying the vast problems confronting Veterinary Husbandry workers He deprecated the tendency to separate the problem into loose compartments of Animal Husbandry and Veterinary Science and pointed out that 'Experience has repeatedly shown that whenever the problems have been separated into the loose compartments of Animal Husbandry and Veterinary Science interests have clashed and improvements been retarded After all an animal forms one biological entity and the ideal that its evolution can be brought about by divided administrative units is irrational and unsound

Referring to the role played by livestock in the economy of the country and how greater weatlh and well being of the country are linked with animal husbandry improvement Dr Datta observed 'By providing transport for agricultural produce it is estimated that cattle contribute annually approximately 160 crores of rupees, while by way of cattle labour for agriculture, India gets about 300-400 crores of rupees every year Our cattle produce about 1,000 million tons of dung per annum nearly 67% of which is burnt as fuel whereas the rest is available as manure Assuming a value of even Rs 10/ per ton, the total worth comes to about 1,000 crores of rupees India provides 480 million maunds of milk per year, of which half is converted into *ghee* The price of this amount of milk products may be conservatively estimated at 750 crores of rupees The amount of meat consumed in India is about 216 lakh maunds Its value may be put down at 130 crores of rupees The number of eggs produced is over 300 crores per annum, so that they also bring about 30 crores of rupees Annually 583 lakhs of hides and skins are produced in our country, whose value is over 40 crores of rupees The annual production of wool is about six lakh maunds, whose wholesale price is about 3 crores of rupees'

Comparing the income derived from livestock with that from several industrial commodities like coal, which yields only 500-600 crores and steel, which yields only 10 crores over which much money is spent and a good deal of effort is being expended, Dr Datta observed that they fall a large way behind the somewhat underdeveloped and neglected Animal Husbandry of the country, so far as national prosperity is concerned

Referring to the steps that are being taken to control live stock diseases and to the problems connected with animal nutrition, Dr Datta remarked that while these short term policies can help to increase the efficiency of our animals to a great extent, maximum benefits can only accrue if scientific systems of breeding are taken recourse to bring about improvement in their genetical constitution, so that it will be feasible to reduce the number and yet to produce greater efficiency This will reduce the cost of the animals as well as of the commodities produced from them so that it will be possible to bring milk, eggs and woolen articles within the reach of the common man Any effort spent in this direction will be the surest means to safeguard the public health

In our Constitution it has been laid down said Dr Datta that "the State shall endeavour to organize agriculture and animal husbandry on modern and scientific lines and shall in particular, take steps for preserving and improving the breeds, of cattle', but unfortunately the total amount spent on Veterinary and Animal Husbandry projects at present is only 0 08 per cent of the total budget grants

Laying before the country an ambitious programme of all round development of verterinary husbandry in all its aspects of conservation, improvement and utilization of livestock, so that our country may be free from epizootic diseases, and the animal might be fed properly and we might have better and more efficient breeds, Dr Datta spoke of the dearth of properly trained and equipped personnel for this gigantic task India has about only 10 veterinary surgeons per million head of livestock compared to 35 and 248 respectively in the United Kingdom and Switzerland

Dr Datta also referred to the need for reorganizing Veterinary education in the country and urged for the creation of an Indian Veterinary Council which should be a statutory body set up by Act of Parliament This Council could enforce a certain high standard in all the Veterinary Colleges It could interest the Central Government to create an All India Service of Veterinarians from which the States could draw in times of emergency It could also act as the coordinating factor between the various State veterinary departments Finally, it could put down all quackery in the veterinary profession

TERRAMYCIN

Streptomyces rimosus, an actinomycete isolated from soil was found to produce an active agent effective against a variety of Gram positive and Gram negative pathogens A team of scientists of Chas Pfizer & Co Inc U S A spent several months to obtain a pure crystallin substance from the metabolic filtrate of this microorganism and it is now coming to the world market as a medicine for whooping cough, syphilis, gonorrhoea, and amoebiasis It is hopeful that the drug shows a very low degree of toxicity in experimental animals The well known antibiotics streptomycin aureomycin, chloromycetin and neomycin are all products of different species of *Streptomyces* and this is a new addition to this group of antibiotic agents (*Science*, *85*, 111, January 1950)

CANCER STUDY ISOTOPES FREE OF CHARGE

The U S Atomic Energy Commission has announced that it will make available without charge to qualified cancer research workers in the U S all radioisotopes now being sold Under the program of the AEC, three radioisotopes—those of iodine, phosphorus, and sodium— were available free of production costs for use in cancer research

The new policy will make available on a free basis the radioisotopes of more than 50 additional elements Notable among these are cobalt 60, which promises to become an effective substitute for radium, and the radioisotopes of gold and carbon

The new program has been made possible through the improvement of isotope production techniques at the Oak Ridge National Laboratory, Oak Ridge, Tenn , and at the Argonne National Laboratory, Chicago, Ill A sum of $450,000 has been set aside to defray the cost of the new program during its first year of operation The free isotopes will be allocated for the following purposes (1) cancer investigations involving animal subjects, (2) research programs studying basic cellular metabolism of cancerous cells, and (3) experimental programs designed to evaluate the therapeutic use of radioactive materials The only charge to be made will be a nominal $10 for handling In those cases where the isotopes are synthesized into a chemical compound, the user will be required to pay for the cost of synthesizing the compound but not for the radioisotopes The same controls over distribution program now in effect will be continued (*Chemical and Engineering News*, March 7, 1949)

PALAEOBOTANY IN INDIA

The Seventh report of the progress of Palaeobotany in India edited by Dr R V. Sitholey of the Birbal Sahni Institute of Paleobotany shows promising achievements of our Palaeobotanists both in Pure and Applied Research This is the first issue of the *Bulletin* since the death of its greater Founder—Editor, late Prof B Sahni It is encouraging that the publication of the *Bulletin* is being continued for the benefit of the workers here and abroad

About eighty one Abstracts and Reports of papers cover a wide range of placobotanical investigations with collections from Pre Cambrian and Cambrian to Pleistocene There are a few additional notes and news mostly relating to the activities and organization of the newly created Institute of Palaeobotany

The growing interest in microfossils among the workers in this country is a noteworthy feature About one third of the papers are devoted to this subject This shows a strong bias to Applied Research specially with reference to the problems of dating, correlation of coal seams and geological rock successions for prospecting work It is certainly a promising indication towards the development of other aspects of Applied Micropalaeobotany in India, namely exploration of coal seams in unproved area, determination of the nature of coal from its contained microflora as a part of physical and chemical survey of Indian coal, use of microflora in petroleum, approaching ecological problems with news ideas, and the manifold prospects of Palynology as outlined in one of the abstracts of the *Bulletin* by the Late Professor Birbal Sahni

The notable contributions to Micropalaeobotany include examination of control rock samples from the Cambrian strata of the Salt Range with reference to further observations on the Age of the Saline Series problem, of dating Barmer sandstone correlation of coal seams at Bokaro coal field and Tertiary succession in Assam, and some articles by Professor Sahni, on the possibilities of Microfossils in Applied Research with reference to India

Unfortunately the *Convenor* and the *Editor* of the *Bulletin* have overlooked a number of important papers on the correlation of coal seams, and problems relating to dating with special reference to the examination of control samples by workers in Calcutta This type of ommission may obviously hamper the purpose of the *Bulletin* for which it is meant.

The Abstracts of papers on impressions and petrifactions include important observations on the morphology of 2 species of British Carboniferous ferns, the new group of Jurassic gymnoperms—Pentoxyleae (already published), further examination of the Pleistocene flora of the Karewa formations in Kashmir, and records of a number of petrified trunks, fruits and impressions from different beds and localities A short report on a petrified forest in Central India appears to be very interesting Such places should be maintained under protection as Field Museums

Apart from recording new facts as to the morphology and evolutionary tendencies of our past floras, the Palaeobotanists in India are gradually exploring the great economic possibilities in our microfossils following the workers in England, Holland, Germany, Sweden, U S S R and U S A Progress of such work here has been nicely presented in the *Bulletin*

Palaeobotany has a great future in India, and this *Bulletin* under review assumes the responsibility for playing an important and unprejudiced role in co ordinating Palaeobotanical researches carried out at different places of this country (*Jour Ind Bot Soc 29*, 1 46, 1950) *J S*

SYNTHETIC RUBBER FROM TURPENTINE

A new type of high quality synthetic rubber made with a chemical derived from turpentine, has been developed at the Bureau of Agricultural and Industrial Chemistry Under present conditions rubber from turpentine is somewhat more costly than GR-S rubber, stretches better, and generates less heat under stress The resulting synthetic rubber has a tensile strength of about 3800 psi , will stretch to seven times its length, and in standard tests develops to 18° F less heat under stress than similarly produced and compounded GR-S rubber

Main ingredient of the new elastomer is isoprene, a compound that forms the basic molecular unit of natural rubber It is obtained from turpentine by a special molecule splitting process developed by Bureau scientists Isoprene produced from petroleum is already used in some types of synthetic rubber now on the market The Bureau s method of producing it from turpentine should be a valuable national asset in the event of emergency shortages of petroleum (*Journal of the Franklin Institute, March*, 1950)

VERY THIN CRYSTAL OSCILLATOR PLATES

The increasing interest in high frequencies for radio communication is accompanied by a demand for very thin quartz crystal oscillator plates having fundamental frequencies up to 100 megacycles or higher In crystals whose frequency is in the higher range, the thickness of the quartz plate determines the frequency , the higher the frequency the thinner the crystal must be A crystal with a fundamental frequency of 100 Mc is about 0 001 in thick, and its surfaces must be parallel within a few millionths of an inch

The usual crystal grinding methods and machinery have proven inadequate for producing plates of the required thickness The National Bureau of Standards has therefore developed improved equipment, capable of producing 0 001 in thick quartz crystals with a high degree of parallelism and flatness The apparatus can also be used to produce equally thin wafers from a variety of other materials, for example, extremely thin dielectric plates for miniature radio condensers (*Journal of the Franklin Institute*, March 1950)

MICROFILM READER AND THE MICROFILM PROCESS

A simple, inexpensive, and practical reader is available in the common box type substage lamp used with a low power microscope A piece of glass the size of the top, fastened at the ends with adhesive tape and raised so as just to permit the film to slide through, will hold the film steadily in focus A magnification of about 10 × affords a visual impression slightly smaller than the printed original, and with wide field oculars will accommodate a page at a time With the substage viewer, perfect processing of the film is not important, because underexposed or overdeveloped films are still legible The viewer may be used for perforated or non perforated film as well as for 16 mm strips, which is not the case with some commercial readers

Library equipment for microfilming is elaborate and expensive For personal use 35 mm camera has proved satisfactory when provided with a supplementary lens to shorten the focus and with a focussing attachment for centering the field

It is estimated that more than 25 billion records have been microfilmed during the twenty years that this process has been used

A useful directory of microfilm services in the United States and Canada is available from the Special Libraries Association, 31 East 10th Street, New York City, which lists institutions, commercial firms, costs, stipulations and conditions concerning this important process (*Science*, March 31, 1950)

NEW ACETYLATING AGENT

Isopropenyl acetate is a new chemical of great potential value in a number of syntheses Characteristic examples are acetylation in which the mild and easily controlled conditions associated with this reaction recommend the reagent's use with many compounds otherwise difficult to acetylate , reaction with alcohols and amines to form new esters or amides , reaction with acids to produce anhydrides of unsaturated and aromatic acids and polymerisation to form either low molecular weight, viscous liquids or when co polymerised with other monomeric compounds, solid polymers

The acetate is prepared commercially by the reaction of ketone with acetone in the presence of an acid catalyst This reaction is reversible and the original components may be readily obtained under the influence of heat and a suitable catalyst

Isopropenyl acetate is a water white liquid, specific gravity 0 9202 and boiling point (748 mm) 96 6°C Flash point is 14 5°C (58 1°F) Normally the commercial grade, has an ester content of approximately 98 100 per cent

The most valuable property of this new Industrial chemical is its ability to act as acetylating agent Thus, from acetaldehyde and paraldehyde it is possible to prepare vinyl acetate , from crotonaldehyde, I acetoxy-I, 3-butadiene , from ethacrolein the monomeric substance I acetoxyisoprene and from acetophenone, a-acetoxystyrene These are all polymerisable monomers which may be converted into commercially useful polymers (*The Chemical Age*, April 15, 1950).

THE ELECTROCHEMICAL SOCIETY INDIA SECTION

The Inaugural Meeting of the Indian Section of the The Electrochemical Society Inc was held on March 23 1950 at the Indian Institute of Science Bangalore in the presence of a distinguished gathering of scientists engineers, industrialists and others

Dr B K Ram Prasad in his Inaugural Address on Some Aspects of the Development of Electro chemical industries in India indicated that there were great possibilities for the development of these industries keeping in view the availability of raw materials present output of electric power and future power development plans The speaker felt glad that the Government of India had decided to establish an Electro Chemical Research Institute at Karaikudi and expressed the hope that the Planning Commission recently set up by the Government would consider in detail the development of Electro chemical Industries in India

The following were elected officers of the India Section

Chairman Dr B K Ram Prasad Special Officer Electric Grid Offices Govt of Bombay Bombay *Secretary Treasurer* Dr T L Rama Char Lecturer in Electro chemistry Indian Institute of Science Bangalore

The Electrochemical Society is an international organization founded in 1902 to promote the advancement of Electro chemistry Electro metallurgy Electrothermics Electronics and allied subjects The membership is well represented by scientists and engineers actively engaged in the various branches of Electro chemistry

REWARDS FOR DISCOVERY OF URANIUM AND BERYL ORES

Rewards upto Rs 10 000/ may be given for the discovery in India of deposits of Uranium ore by the Government of India In the case of Uranium the new deposits would have to be not less than 100 miles and in the case of Beryl 50 miles from any other deposits of these ores the existence of which is already known to the Indian Atomic Energy Commission

The maximum value of this award is to be given for the discovery of deposits capable of producing 100 *tons of Uranium Oxide in ore assaying not less than* 0 4% U_3O_8 A similar discovery capable of producing 100 tons of Beryl assaying not less than 12% BeO or other Beryllium mineral in proportionate amount may earn an award of up to Rs 2 000

Should new deposits of both ores though not sufficient to be of economic importance in themselves justify prospecting in the neighbourhood for further deposits Government may grant funds for this purpose Grants in aid for mine development are available to applicants who produce and deliver not less than 20 tons of Uranium ore and 50 tons of Beryl ore from a concession of mining lease not previously worked for these ores

In order to help prospectors the Atomic Energy Commission will make without charge tests of samples submitted and where necessary further chemical and field tests for determination of ores

Applications for rewards should be addressed to the Secretary Atomic Energy Commission Central Secretariat North Block New Delhi

TWO HUNDRED RESEARCH SCHOLARSHIPS INSTITUTED

In pursuance of the recommendations of the Scientific Manpower Committee the Ministry of Education Government of India have instituted 50 Senior and *150 junior research training scholarships in universities* and other educational and research institutions

The objective of the scheme is to enable deserving and talented students to engage in scientific and industrial research and to acquire as a result of such training knowledge and experience for holding research positions

The scheme provides for two grades of scholarships tenable for a period of three years senior scholarships of Rs 200 per month and junior scholarships of Rs 100 per month

The Senior scholarships are available for advanced research in basic science and for post graduate research in engineering and technological subjects The scholarships are to be awarded to research workers who have taken at least a Master s degree in science or a good degree for advanced diploma in engineering or technology

The junior scholarships are available for research of comparatively lower standards at post graduate level, and are to be awarded generally to those who have taken at least a good Honours degree in science or a degree in technology

In the terms and conditions governing the award of the scholarships it is laid down that the heads of the institutions concerned shall make the award strictly on the basis of merit subject to the approval of the Government of India The grants on account of the scholarships will be given to the institutions concerned in quarterly instalments in advance and the heads of the institutions will disburse the amount to the scholars at the end of every month It is also laid down that the heads of the institutions will submit quarterly reports on the satisfactory progress of the work of the scholars to the Government of India The continuance of the scholarships will depend upon the scholars making satisfactory progress with their work

DEVELOPMENT PLANS FOR PUNJAB (I)

The Punjab (I) Government is getting plans ready to absorb the Bhakra Nangal electricity output of 310 000 kw

At present the State s entire industry can absorb little more than *55 000 kw An additional output of* 72,000 kw to be generated next year by Nangal power is to be diverted to Delhi Bikaner and U P At the moment Mandi supplies 30 000 kw and local thermal sets 25 000 kw Next year thermal sets are to stop functioning and Mandi s power will be diverted gradually to Punjab (P) Ferozepore will receive its electricity from Mandi *via* Lahore

If the State had planned earlier it could have absorbed Nangal s energy in addition to that of Mandi The use of Mandi power for home industries would have been far more profitable

The Government has set up a planning committee of secretaries and departmental heads to study the report of the State s industrial commission The committee will furnish the National Planning Commission with facts and figures regarding the State s agricultural and industrial potentialities

The Government wants a trained mineralogist to survey the State s resources Later a cabinet committee for the development of industry will be set up to consider a proposal to utilize 180 000 kw from Bhakra This will include the planning and creation of number of major and auxiliary industries within the State

The committee will devote its attention to the planned development of cottage industries using power machinery It will also draw up plans for the expansion of textile handloom and sericulture industries The State s supply of oilseeds would be used for manufacturing edible oils

There is also scope for industries depending on raw products f agriculture The sugarcane produce of the State could be utilized if the number of mills was increased This alone would consume over 20 000 kw

Means have yet to be devised to make trading conditions attractive to industrialists Refugee industry is to be developed at the 12 industrial townships and also at the site of the capital the combined efforts will consume about 55 000 kw

DR H K NANDI

Dr H K Nandi whose appointment as Director of Agriculture Government of West Bengal was announced earlier (see *Science and Culture 15* 396 1950) is a distinguished alumnus of the Calcutta University

Dr Nandi graduated with Honours in Botany from the Presidency College Calcutta in 1929 and later took his master s degree in Botany from the University College of Science Calcutta in 1931 In his early years he worked under Prof S P Agharkar the then Ghosh Professor of Botany of the Calcutta University on the systematics and biology of the *Podostemaceae* In 1933 Dr Nandi proceeded abroad and joined the King s College London where he worked under Dr R Ruggles Gates F R S and obtained his Ph D degree on his thesis on the origin of the cultivated rice

On his return to India he was appointed Cytogeneticist at the Bose Research Institute Calcutta in 1936 and where he continued investigations on the interspecific hybridisation of rice

In 1938 Dr Nandi was appointed Economic Botanist to the Govt of Assam and since 1945 he has been serving as Deputy Director of Agriculture Govt of Orissa He has thus acquired considerable experience on the crops of two contiguous provinces of West Bengal and it is hoped that agriculture in West Bengal will have a new orientation under his able leadership Dr Nandi has got 30 publications in different agricultural subjects to his credit some of which were published in the best scientific journals of the world

ANNOUNCEMENTS

Prof M S Thacker Head of the Power Engineering Laboratory Indian Institute of Science has been appointed Director Indian Institute of Science Bangalore

Under the United States National Student Association s Foreign Student Summer Project at the Massachusetts Institute of Technology the following have been awarded the studentship for 1950 tenable from June 6 to September 16 1950 Sri G Janaki Ram and Dr S Laha Indian Institute of Science Bangalore Dr A N Lahiri Fuel Research Institute Digwadih Dr M S Sinha Bose Research Institute Calcutta and Sri K S Venkatraman College of Engineering Trivandrum

The M I T has waived tuition costs for the students while expenses in U S A such as room board books and incidental expenses will be borne by the Foreign Student Summer Project Committee Air passage to U S A and back for these candidates will be provided through the Fullbright Foundation

Sri S L Tandon Lecturer in Botany Delhi University has been appointed research assistant in botany at the State College of Washington Pullman Washington

The 12th Annual Meeting of the British Association for the Advancement of Science will be held at Birmingham from August 30 to September 5 1950 Sir Harold Hartley President will deliver his address on Man s Use of Energy

The 12th International Congress of Pure and Applied Chemistry will be held in New york City from September 10 to 13 1951 On this occasion the American Chemical Society will celebrate its 75th anniversary from September 4 7 1951 the International Union of Pure and Applied Chemistry will hold its 17th conference on September 8 9 and will close its conference in Washington where it will celebrate the fiftieth anniversary of the founding of the National Bureau of Standards

President James B Conant of Harvard University is Honorary President of the Congress Further details may be had from Harry L Fisher Division of Chemistry National Research Council 2101 Constitution Avenue Washington 25, DC

The Second General Assembly and International Congress of the International Union of Crystallography will be held in Stockholm from June 27 to July 3 1951 Further information may be had from Mr R C Evans General Secretary of the Union Crystallography Laboratory, Cavendish Laboratory, Cambridge England

Dr Ernest Zipkes formerly head of the Department of Road Research Federal Institute of Technology Zurich (Switzerland) has been appointed Director of the Central Road Research Institute Delhi

The following research fellowships have been awarded by the National Institute of Sciences of India for 1950–52

NIS Senior Research Fellowships

Mr S P Basu to work on Some Physico Chemical factors affecting fresh water fish cultural practices in India at the All India Institute of Hygiene & Public Health Calcutta (For a year only)

Dr Sukh Dev for Studies in Sesquiterpenes at the Indian Institute of Science Bangalore

Dr P B Mathur to work on Preventive Measures to eliminate the loss of vitamin C during storage in potato tubers at the College of Agriculture Banaras Hindu University Banaras

Mr V R Thirunenkatachar to work on Compressible Fluid Flow at the Central College Bangalore

Imperial Chemical Industries (India) Research Fellowships

Mr C Balakrishnan for Study of Internal Conversion Co-efficients of Radio isotopes at the National Physical Laboratory New Delhi

Dr I M Chak *to work on Preparation of Haemostatics* from oil-seeds at the Indian Institute of Science Bangalore

Mr A G K Menon for Ichthyological Studies with Special reference to Zoogeography at the Zoological Survey of India Calcutta

Dr G C Mitra, for Morphogenetic studies The origin and development of the leaves and their parts at the shoot apices of Angiosperms at the Calcutta University

NIS Junior Research Fellowships

Mr V Chandrasekharan to work on The scattering of light in crystals and determination of elastic constant at the Intian Institute of Science Bangalore

Mr A K Chaudhuri to work on Electron Optics of the Electron gun used in Electron Microscopy at the Calcutta University

Dr G S Deshmukh to work on Analytical aspect of Cerium and Thorium Chemistry at Banaras Hindu University Banaras

Dr B D Mundkur to work on Heredity and Variation *in Ascomycetes particularly antibiotic yielding Fungi* at the Bombay University

Mr N Satapati to work on Petrology Petrochemistry and Petrotectonics of Eastern Ghats at the Andhra University

Dr G Venkatachalam to work on Animal Breeding including Animal Genetics & Applied Statistics at the Livestock Research Station Hosur

Dr (Mrs) Vidyavati to work on Problems in the Anatomy of *Labeo rohita* at the University of Delhi

ERRATA

In May 1950 issue p 410 column 1 line 35 *read* Barber *for* Barbour p 411 column 1 line 45, *read* plot *for* plate p 446 column 2 line 36 *read* macroscopically *for* microscopically p 451 column 1, line 18 *read* pressure *for* presence

---

LETTERS TO THE EDITOR

[The Editors are not responsible for the views expressed in the letters]

CALCIUM GLUCONATE FROM CANE SUGAR

In the manufacture of calcium gluconate a very important salt used in calcium therapy, pure crystalline dextrose is almost always employed as the starting material Only a passing mention is made by Losin[1] of the production of calcium gluconate by the fermentation of cane sugar The authors using a modification of the electrolytic process originally developed by Isbell[2] and studied by Fink[3] successfully produced a few tons of calcium gluconate from cane sugar The quality of the product was comparable to that from pure dextrose and the cost of production was no higher This is of particular importance as practically no pure dextrose is at present produced in India at competitive rates

A 70% solution of cane sugar in warm water was hydrolysed by boiling with 2 gms of conc sulphuric acid per litre of solution for 10 to 15 minutes The sulphuric acid was removed by precipitation as barium sulphate and the electrolytic oxidation of the hydrolysate was carried out under the following conditions

Concentrations of glucose in the electrolysate 18% 20% KBr 1% NaCl 1% and calcium carbonate in suspension 5% Cathodes and anodes of Acheson graphite were used and the approximate current density was 0 6—1 0 amp per sq dm The current efficiency under these conditions was about 90% and calcium gluconate cyrstallized out of the electrolysate when nearly all the glucose was oxidized The fructose (as when cane sugar is used) somewhat contaminates the final product This is in fact one of the major difficulties in using cane sugar as starting material The bulky nature of calcium gluconate renders its purification from fructose all the more difficult However on recrystallization and repeated washing yields of about 20%—25% on the weight of cane sugar could be obtained The material so prepared conformed to the B P standard

It was possible to use the mother liquor from the crystallizations for electrolysis by adding more cane sugar hydrolysate, bromide chloride mixture and calcium carbonate But the repeated use of the mother liquors entails large accumulation of fructose and both the yield and quality of the calcium gluconate suffer ultimately At this stage the syrup containing about 12% calcium gluconate and 40% 50% fructose may be used directly for oral consumption or the calcium gluconate recovered from the syrup as the basic salt The commercial success of the process will depend largely upon the use to which this mother liquor is put to However in our large scale production the mother liquor syrup was discharged

20 porcelain cells of 5 gallons capacity were used and a daily semi commercial scale manufacture of 30 lbs of calcium gluconate was kept up for several months

S Balsundaram
R K Hirani
V Subrahmanyan

Department of Biochemistry,
Indian Institute of Science,
Bangalore 3, 1 11 1949

[1] Losin Carlos L *Sugar news* *20* 467 470, 517 21 1930

[2] Isbell, H S *et al* *Industrial Eng Chem* *24* 375 1932

[3] Fink C G and D B Summers *Trans Electrochem Soc*, *74*, 24, 1938

ON THE BIONOMICS OF THE CARP, *THYNNICHTHYS SANDKHOL* (SYKES)

Thynnichthys sandkhol is one of the indigenous South Indian carps about the bionomics and environmental conditions of which much detailed information is not available It is an interesting example of discontinuous distribution, and is regarded as an evidence of Malayan affinities in the freshwater fauna of peninsular India [1,2] The genus *Thynnichthys* Bleeker is mostly confined to the Far East, *T tynnoides* (Blkr) and *T polylepis* Blkr occurring in Borneo and Sumatra[3], Malaya states[4] and in Siam[5,6] *T sandkhol* Sykes, occurs in Malaya[7] and in South India where it appears in the Godavari and Krishna[8] and in the Tungabhadra[9] The elucidation of the natural breeding and nursery areas and of the food and feeding habits of this species is made in this note for the first time This is of considerable importance for the fish though less common than *Catla catla* (Cuv & Val) and *Labeo fimbriatus* (Bloch), can now be added to species that are propagated in the provincial waters of Madras

This medium sized carp may be easily recognized by its silvery sheen, minute scales and spindle-shaped body It attains maturity when about 12 inches in size, and spawns during the S W monsoon (June September) in the three major rivers, when they are highly turbid with water temperature ranging from 28 4—29 6°C The waters are also alkaline and well saturated with oxygen (Table I)

TABLE I

Hydrological conditions	Godavari	Krishna	Tungabhadra
Date	13 9 49	15 7 49	20 9 49
Turbidity in cms	3 0	3 5	7 5
Temperature °C	29 6	28 4	.28 6
*p*H	8 0	8 2	8 0
Dissolved O_2 (mg/l)	4 2	5 2	5 879
Free CO_2 (pp 100 000)	nil	nil	0 253
Carbonates (pp 100 000)	0 308	0 775	nil
Bicarbonates (pp 100 000)	4 0	9 77	6 710
Chlorides as Cl (pp 100 000)	0 8	2 0	0 4
Silicates as SiO_2 (pp 100 000)	1 24	1 12	1 040
Phosphates as P (pp 100 000)	0 046	0 051	nil
Nitrates as N(pp 100 000)	nil	nil	nil

The hatchlings enter tanks, ponds and swamps connected with these rivers and grow to a size of 18 to 24 inches and weight of 2 to 3 lbs by the summer months of March, April and May, when they are netted and marketed by the local people As these waters get dry during summer, it is evident that the rate of growth of this fish is highly satisfactory The following (Table II) are the hydrological conditions of three waters in which the species grows and attains marketable size within 8 to 10 months These conditions do not seem to differ much from those of spawning given in the previous table

TABLE II

Hydrological conditions	Jallakalva (E Godavari)	Kankipadu tank (Krishna dt)	Edurur swamp (Kurnool dt)
Date	13 9 49	16 7 49	23 9 46
Turbidity in cms	3 2	2 6	5 5
Temperature in °C	29 6	31 0	33 2
Free CO_2 (pp 100 000)	nil	0 52	0 138
Carbonate (pp 100 000)	0 308	nil	nil
Bicarbonate (pp 100,000)	15 350	12 92	8 845
*p*H	8 0	7 8	7 9
Dissolved O_2 (cc/l)	4 100	4 680	5 400
Chlorides (pp 100 000)	3 2	8 0	0 9
Phosphates (pp 100 000)	nil	0 03	nil
Silicates (pp 100 000)	1 20	0 8	1 04
Nitrates (pp 100,000)	nil	nil	nil

Over one hundred specimens of the fish were collected from these areas, for the determination of the natural food Both the young ones and adults are predominantly plankton feeders Sandgrains and mud also occurred in some of the guts examined The following is the composition, in average percentage volume, of the diet of the fish

Myxophyceae *Anabaena*, *Gleotrichia*, *Merismopedia*, *Microcystis*, *Oscillatoria* and *Spirulina* 25%,

Chlorophyceae *Ankistrodesmus*, *Chroococcus*, *Closterium*, *Coelastrum*, *Cosmarium*, *Crucigenia*, *Eudorina*, *Gonatozygon*, *Mougeotia*, *Oedogonium*, *Oocystis*, *Pediastrum Pleurococcus Scenedesmus Sphaerocystis Spirogyra* and *Tribonema* 40%

Diatomaceae *Achnanthes Amphora Anomoeneis Cocconeis Cyclotella Cymbella Eunotia Fragilaria Gomphonema Gyrosigma Melosira Navicula Nitzschia Pinnularia Rhopalodia Surirella Synedra* and *Tabellaria*—15%

Protozoa *Chlamydomonas Euglena Trachelomonas Glenodenium Phacus and Stylonichia*—5%

Rotifera *Conochilus Diurella Pedalion Rotifer* and *Notholca*—5% and Crustacea *Alonella Bosmina Ceriodaphina Diaphanosoma Simosa Stenocypris Diantomus Eucyclons* and *Microcyclons*—10%

We are thankful to the Director of Fisheries Madras for according permission for the publication of this note

P I Chacko
S V Ganapati

Freshwater Biological Station
Kilpauk Madras 29 11 1949

[1] Hora S L *Proc Nat Inst Sci India* *10* 423 439 1944

[2] Bhimachar B S *Curr Sci* *14* 1 1945

[3] Weber M & Beaufort L F D *Fish of the Indo Australian Archipelago Leiden* 3 1916

[4] Herre A C W T & Myers G S *Bull Raff Mus Singapore* *13* 59 1937

[5] Hora S I *Journ Siam Soc Nat Hist S ppl* *6* 143 184 1923

[6] Smith H G *Bull U S N t Mus* *188* 209 210 1945

[7] Maxwell C N *Malayan F shes Singapore* 1921

[8] Day F *The Fauna of British India Fishes London* *1* 1889

[9] Chacko P I and Kuriyan G K *Proc Indian Acad Sc* *28* 166 176 1948

THEORY OF THE CORONA DISC COLOURS

The coronas are rainbow coloured concentric rings seen around a bright source of light when viewed through a thin cloud or a fog With monochromatic light the corona consists of alternate bright and dark rings The first order dark ring experimentally observable has angular aperture varying between 3° to 20° in the direction of observation The central disc of the corona is illuminated with maximum intensity of light when monochromatic light is used With white light the central corona becomes intensely coloured the colour depending on the size of the drops The colour changes abruptly with the change in the size of the drops and can best be observed by allowing an artificial cloud formed in a flask to evaporate slowly

The corona formation is explained by the diffraction theory due to Verdet[1] This theory explains the maximum intensity of the central corona disc with monochromatic light but fails to give a satisfactory account of the preponderance of one colour over the others when white light is used According to the diffraction theory the central disc colour should be white Aitken[2] Barus[3] and others have studied the colouration of the corona discs, but no satisfactory explanation of this has been obtained.

In 1908 Mie[4] had proposed a general theory of light scattering which was used by the author[5] and co workers to study the scattering of light by large sized water drops This required the evaluation of a number of scattering functions depending on Bessel functions of high order These theoretical results explained the experimental observations of the scattering of light These results are also found to be useful in explaining a number of optical phenomenon in the atmosphere Meeke[6] used the Mie s theory to explain the formation of the rainbow and the supernumery bows The numerical results of Mie s scattering theory are capable of explaining not only the colours of the corona discs but also of coronas Broken Bows and transmission of light In this note an explanation of the colours of the corona discs is given on the basis of Mie s theory

The angular apertures of the corona discs does not exceed by about 20° in the line of observation It is therefore necessary to find the maxima of intensity for the angles of scattering lying between π and π 20° The intensity of light depends mainly on $\alpha = 2\pi\rho/\lambda$ the ratio of the circumference of the drops of radius ρ to the wave length of light λ The results of the intensity of scattered light[5] within these angular apertures for different values of α indicate that the intensity fluctuates with change in α and is a maximum for values of α 6 8 or 15 Thus for a given wave length of light there are three distinct sizes of the drops for which the intensity of light becomes a maximum The following table shows relatively the experimental observations of Barus[3] and the results from Mie s theory

Colour of the corona discs	Radius of drops in μ for different α					
	$\alpha = 6$		$\alpha = 8$		$\alpha = 15$	
	Mie	Barus	Mie	Barus	Mie	Barus
Red (7000 A U)	0 621		0 828	0 80	1 55	1 60
Green (5000 A U)	0 470		0 637	0 65	1 19	1 15
Violet (4000 A U)	0 380		0 509	0 55	0 955	0 95

The above table indicates that there is a fairly good agreement between theory and experiment A fuller account of the applications of Mie s theory to other optical problems will be published elsewhere Further experimental work in this direction is in progress

Y G Naik

Gujarat College
Ahmedabad
31 12 1949

[1] Verdet *Ann chim et Phys* (3) 34 137 Physics of the Air by Humphrey pp 528

[2] Aitken *Proc Roy Soc* *17* 195 1890

[3] Barus Carnegie Institute of Washington 3rd Report p 60, 1908

[4] Mie *Ann d Phys* *25* 377 1908

[5] Paranjpe Naik and Vaidya *Proc Ind Acad Sci* *9* 353, 1939 *ibid* *9* 352 1939

[6] Meeke *Ann d Phys* *61* 471 1920 *ibid* *62* 623 1920, *ibid*, *65* 257, 1921

ENERGY OF HOMOPOLAR BONDS

The object of this note is to present a simple method of calculating the purely covalent bond energy of homopolar diatomic molecules This energy is given by $\frac{e^2}{2r\sqrt{n(n+2)}}$ (1) where e is the electronic charge r the internuclear distance and $\sqrt{n(n+2)}$ is the *spin* factor of the shared electrons The value of n is 1 for halogens and 2 for hydrogen and akali metals The purely covalent energy is therefore 1/3 46 of the Coulombic energy for halogens and 1/5 66 in the case of hydrogen and alkali metals The results are given in the following tables

TABLE I

Bond (A A)	dist	ionic nature	bond energy	obs cov bond energy	cal cov bond energy	spin factor
	γ°A	$i-\frac{h}{er}$	P	$\left(P-i\frac{e^2}{r}\right)$	$\frac{e^2}{2r\sqrt{n(n+2)}}$	$\sqrt{n(n+2)}$
H H	0 74Sc	0 05	103 4	81 4	79 3	2 82
F F	1 44Sc	0 014	70 0Sp	66 8	66 6	1 73
Cl Cl	1 98P	0 024	56 9Sp	52 9	48 4	1 73
Br Br	2 28P	0 032	45 2Sp	41 6	42 0	1 73
I I	2 66P	0 043	35 6H	30 0	33 0	1 73

TABLE IB

Bond (A A)	distance	obs bond energy	cal bond energy	sp n factor $n(n+2)$
	γ°A	P	$\frac{\gamma^2}{2r\sqrt{n(n+2)}}$	$\sqrt{n(n+2)}$
Li Li	2 67Ri	26 3	22 0	2 83
Na Na	3 07Ri	18 4	19 1	2 83
K K	3 91Ri	12 6	15 0	2 83
Cs Cs	4 50Ri	10 1	13 0	2 83

H—Herzberg Molecular Spectra and Molecular Structure
Sc Schomaker and Stevenson *Jour Amer Chem Soc* *63* 47 1941
P Pauling The Nature of the Chemical Bond
Ri Rice Electronic Structure and Chemical Binding
Sp—Sponer Molekul Spektren

According to Pauling[1] the bond in the hydrogen molecule is due to the resonance of two electrons between the two nuclei which contributes 80% to the total bond energy The remaining energy should come from the partial ionic binding An assumption of 5% total ionic character i e 2 5% for each of the resonance structure $\overset{+}{H}$ H and H H would be in agreement with the observed result On this basis the ionic binding energy $i\frac{e^2}{r}$ is 22 K Cals The balance of the observed bond energy and the ionic binding energy 81 4 K Cal compares favourably with the value 79 3 K Cal calculated from the equation (1) and also is in full agreement with the calculation of James and Coolidge[2] which are based upon a thoroughly satisfactory theoretical treatment It is not therefore necessary to ascribe 15% of the bond energy of hydrogen to complex interaction and deformation terms (Pauling[1]) Although the small ionic character of hydrogen has been indicated by a moment 0 015 measured by Watson[3] this value is not enough to account for the observed value of 5% from bond energy data The covalent bond energy calculated from equation (1) by taking the internuclear distance of hydrogen as 0 6° observed in all covalent bonds is however in full agreement with the observed

In the case of halogens small electric moments of the order of 0 1 to 0 4 have been reported which would indicate definite partial ionic character due to resonating structures Cl Cl Cl $\overset{+}{\text{Cl}}$ Cl Cl These values are given in Table I column (3) The purely covalent bond energies after correcting for the ionic binding given in Table 1 column (5) compare favourably with those calculated from the formula (1) and are within the uncertainties of the bond energy values

In the case of alkali metals the agreement between calculated and observed values is fair The bond energies are not known with any degree of accuracy

S K KULKARNI JATKAR
(MISS) S B KULKARNI

General Chemistry Section
Indian Institute of Science
Bangalore 3
21 1 1950

---

[1] Pauling The Nature of the Chemical Bond
[2] James and Coolidge *Jour Chem Phys* *1* 825 1933
[3] Watson H F *Proc Roy Soc* *132* 569 1931

EFFECT OF REFINING AND DEODORIZATION OF COCONUT OIL ON CALCIUM UTILIZATION

It has been shown by balance experiments on human subjects[1] that the detrimental effect of coconut oil on calcium metabolism is aggravated when the oil is subjected to the processes of refining and deodorization Since a large amount of coconut oil in the refined and deodorized conditions is consumed for dietry purpose further investigation dealing with the problem of nutritional importance of refined and deodorized coconut oil using rats instead of human subjects as the experimental animals was carried out

Four adult rats were selected and they were first given the diet D I containing refined and deodorized coconut oil (cocogem of Tata oil Mills Ltd) at 10 p c level of intake After a preliminary period of four days on this diet the urine and faeces of the animals were collected for a further period of four consecutive days on the same diet They were then given the diet D II in which the refined and deodorized coconut oil of D I has been substituted by the crude coconut oil as sold in the market The urine and faeces of the animals on this diet were also collected for a further period of four days after a preliminary period of equal days

Both the diets supplied high grade animal protein and utilizable calcium in the form of defatted milk powder The diets were further enriched with calcium and other minerals by the inclusion of Osborne and Mendel Salt Mixture at 5 p c level so as to counteract the detrimental effect of ordinary crude coconut oil on calcium utilization as observed by Basu and Nath[2] and De Karkun and Roy[3] in their experiment with low calcium rice diet The composition of the diets are shown in table I The calcium contents of the daily diet consumed and of the urine and faeces were estimated according to the standard permanganate method as adopted in our previous communication[1]

TABLE I

SHOWING THE COMPOSITION OF THE TWO DIETS BASED ON CRUDE COCONUT OIL AND REFINED & DEODORIZED COCONUT OIL THE FIGURES ARE EXPRESSED IN GM

Name of the food stuff	Experimental diet D I	 D II
Rice	70	70
Pulse	5	5
Defatted milk powder	10	10
Salt mixture (Osborne & Mendel)	5	5
Crude coconut oil		10
Refined and deodorized coconut oil (COCOGEM of Tata oil Mills)	10	

The results of the balance experiments presented in Tabe II show that with almost an equal intake of calcium when the dietary fat of D I is changed from the refined and deodorized variety to the ordinary crude variety as in diet D II the daily calcium retention is improved from +55 0 mg to +73 2 mg The above low retention of calcium due to refined and deodorized variety of coconut oil is mostly due to higher excretion of this element in faeces and thus indicating that under the influence of the above variety of coconut oil the absorption of calcium through the intestine does not take place properly The present results substantiate our previous observations to show that coconut oil produces highly detrimental effect on calcium utilization when the oil is subjected to the processes of refining and deodorization

TABLE II

SHOWING THE INTAKE EXCRETIONS AND RETENTION OF CALCIUM IN RATS WHEN THEY ARE KEPT ON CRUDE AND REFINED COCONUT OIL DIET THE FIGURES ARE EXPRESSED AS DAILY AVERAGE VALUES PER RAT IN MG

Diet	Dietary intake	Urinary output	Faecal output	Total output	Balance
Refined and deodorized coconut oil diet D I	146 4	4 8	86 6	91 4	+55 0
Crude coconut oil diet D II	143 3	6 1	64 0	70 1	+73 [illegible]

In consideration of the results of the present and previous experiments the authors are of opinion that the manufacture of refined and deodorised coconut oil for edible purpose should not be encouraged

Our thanks are due to the Indian Research Fund Association for a grant to the Nutrition Research Unit of this laboratory which enabled us to carry out these investigations

H N DE
J N KARKUN

Biochemistry and Nutrition Laboratories
Dacca University
Dacca Pakistan
4 2 1950

---

[1] De H N and Karkun J N *I l Jour Da r Sc* 2 114 1949
[2] Basu K P and Nath H L *Ind Jour Med Res* 34 27 1946
[3] De H N Karkun J N and Roy J K Unpublished data. Thesis 1949

DEVELOPMENT OF THE FEMALE GAMETOPHYTE OF *ORYZA COARCTATA* ROXB

The archesporium being hypodermal in origin is differentiated and distinguished in the second layer of the nucellar tissue as a polygonal cell of comparatively larger dimensions with thicker and denser cytoplasm and relatively large nucleus It is strictly confined to a single cell as was observed by Kuwada[2] in *O sativa* No parietal cell is observed to be cut off and the archesporium acts and functions directly as a megaspore mother cell after proper nourishment and development

The m m cell then undergoes a period of rest before meiosis starts In the resting stage the nucleus contains one conspicuous nucleolus embedded in the chromatin network The general cytoplasm is minutely vacuolated throughout at first but bigger vacuoles appear later in the general plasma along with the growth of the cell Its apex is broader and the lower end is tapering After the reduction division a cellplate is formed near about the central region thus dividing it and thereby forming two dyads The second divisions follow simultaneously in both the cells (upper as well as lower) resulting in a linear tetrad of four megaspores Kuwada[2] Terada[4] and Juliano and Aldama[1] observed similar type of development in *O sativa*

Some time after the upper three megaspores show various types of contraction leading to the ultimate degeneration and the chalazal one alone functions These three upper cells after complete degeneration and disintegration are observed as dark staining shapeless masses covering and capping the functional and developing megaspore This disintegrated cap lasts till the 4 nucleate stage of the sac

The development of the female gametophyte is of the usual monosporic eight nucleate (Normal) type

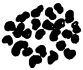


Fig 1 The haploid chromosome number of *O coarctata* Roxb × 2000

The haploid chromosome number is counted as 24 (Fig 1) from the p m cells as was previously reported by Parthasarathy[3]

Fuller details will be published elsewhere

We offer our sincere and grateful thanks to Sri Jyotirmoy Datta office of the Dictionary of Economic Products of India (C S I R) New Delhi for kindly helping with some literature references from his personal library

A K PAUL
R M DATTA

Jute Agricultural Research Institute
Raikes House Hooghly
1 4 1950

[1] Juliano J B and Aldama M J *Philippine Agric* *26* 1 134 1937
[2] Kuwada Y *Bot Mag* Tokyo *24* 267 281 1910
[3] Parthasarathy N *Cytologia* 307 1938
[4] Teranda S *Jour Coll Agric* Hokkaido Imp Univ Sapporo Japan *19* 245 260 1928

NEW REAGENTS FOR THE CHARACTERIZATION AND PURIFICATION OF S GUAIAZULENE

During our work on some sesquiterpenes derived from S guaiazulene it was thought of interest to develop a few new reagents which should form sparingly soluble stable complexes with azulenes and should possess high crystallizing power It should also be possible to readily and easily regenerate the azulene in a pure form from such a compound With this end in view a large number of polynitro compounds were tested for their capacity to form double complexes with S guaiazulene Picramide has been found to be superior to all the formerly known four reagents[1] [2] which are being used for the identification of azulenes Picryl chloride can also be used for the purpose and is in fact superior to styphnic acid and possibly to picric acid in this respect

Picramide readily forms a double compound with S guaiazulene in alcohol acetic acid solution The compound crystallizes in black needles with a coppery red luster and is obtained in a very good yield in a more or less pure form from the crude azulene directly The m p of 163 5 is quite sharp For the regeneration of pure S guaiazulene from the picramide complex three techniques have been developed The compound is refluxed with cyclohexane containing a small percentage of dry benzene when the azulene is regenerated and the picramide precipitates out On cooling the picramide is filtered off and the filtrate after dilution with petroleum ether is passed through a column of alumina to remove the last traces of picramide For larger quantities the addition compound is mixed with an equal amount of an inert material like alumina and placed in the thimble of a soxhlet apparatus and extracted with cyclohexane till the extract is no longer coloured blue The third method makes use of the decomposition of picramide with alkali

Picryl chloride also gives a complex crystallizing in black crystals with a coppery hue m p 97 98° from alcohol The azulene can be liberated from this compound by treatment with alkali

All these methods have been described for S guaiazulene but it is hoped that these reagents may also prove to be equally useful for other azulenes

Full details will be published elsewhere

K B DUTT
SUKH DEV
P C GUHA

Department of Pure & Applied Chemistry
Indian Institute of Science Bangalore 3
3 4 1950

[1] Ruzicka and Rudolph *Helv Chim Acta* 9 118 132 1926
[2] Pfau and Plattner *Ibid* 19 858 1936

NEED FOR INVESTIGATION ON SYNTHETIC MOTOR AND AVIATION FUEL FOR INDIA

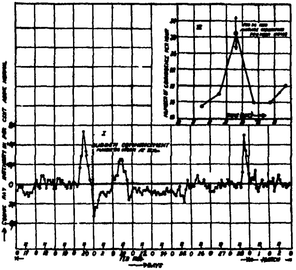
Financial value of loss being sustained by owners of motor cars and transport vehicles year after year since the commencement of restricted supply of petrol can hardly be over estimated

Two projects[1] relating to the possibility of producing synthetic petrol from Indian coal one costing Rs 23 crores and the other Rs 40 crores are under consideration of the Government of India

In course of a symposium held in Allahabad in 1949 Dutta Roy[2] correctly adduced statistical support for the establishment of Research Institute on the subject Stuart[3] discussed the need for synthetic liquid fuel to replace natural petroleum which is limited and the two chief alternative processes now in use in U S A are economically unsound The Minister of Fuel and Power U K[4] stated that the Fuel Research Station of the Department of Scientific and Industrial Research are carrying out researches for several years but results so far obtained do not yet justify plans for operation on commercial scale in that country We have however now before us the Report on the Petroleum and synthetic Oil Industry of Germany – by a Mission from the Ministry of Fuel and Power Published by His Majesty s Stationary Office London This publication offers very little hope for economically successful production of petrol from Indian coal Instead of depending too much on mere reproduction of what Germany was economically unsuccessful inspite of persistent efforts for years it seems quite worth while for India to take up the problem on independent lines based on abundant cheap raw materials which are either available or may be developed with planned long term policy

Berthelot[4] eighty one years ago combined carbon and hydrogen in his research laboratory at high temperature and produced acetylene The subject is therefore an absolutely old one and has been extensively investigated in different scientifically advanced countries for over 80 years so far with no commercial success Let the fuel technologists imitate one of the plants for defence purpose exclusively Such step however should increase of intensity from 6 to 20 hrs with a maximum of 7 9% at 12 hours A magnetic storm of the sudden commencement type began at 23 40 hrs I S T The storm was followed by a sudden decrease in cosmic ray intensity with a minimum of 4 82% at 0 0 hours on 21st Feb At Delhi a partial severe type of radio fade out was observed on 21st between 15 40 to 16 20 hrs I S T On the 22nd there was another rise in intensity of about 3 7% at 11hrs I S T following which there was a drop in intensity below the mean value which continued till the 25th during which period the magnetic storm as reported from Kodaikanal persisted On the 26th it was slightly disturbed and on 27th and 28th it was calm No solar flare up was observed during 20th 22nd Feb at Kodaikanal probably due to bad weather There was however a newspaper report of observation of such an occurrence on 22nd Feb from Japan The group of phenomenon found usually associated with an intense solar flare up was thus observed during the period 20th 25th Feb The cosmic ray intensity attained the normal value from early 26th Feb (iv) On the 28th Feb the ionization chamber record showed an increase in cosmic ray intensity with a maximum of about 7 3% at about 16 hrs I S T and the counter telescope arrangement recorded an increase about 100% at 13 30 hrs approximately (Curve II) The higher percentage increase in counter telescope arrangement seems to indicate that the increase was mainly due to particles of higher energy which also arrived earlier The increase recorded on Feb 28 was of a simple nature neither accompanied by radio fade out nor followed by any decrease in intensity indicating thereby the absence of any ionospheric and magnetic disturbances As this increase could not be correlated with an increase in the number and activity of sunspots or magnetic storm and radio fade out the question arises whether it could be attributed to solar flare up According to the report in *Nature* the group of large sunspots went out of sight on the 27th February Several observations have also been recorded by Ehmert[3] (1941 43) in which increase in cosmic ray intensities could not be correlated with any sunspot activities or radio fade outs

Curves I and II



Our thanks are due to Dr A K Das Director Solar Physics observatory Kodaikanal and to the Research Engineer All India Radio Delhi for supplying us with information used in preparing the present note One of us (*P K S C*) is indebted to the National Institute of Sciences of India for the award of an I C I Research Fellowship We are also indebted to Dr D M Bose Director Bose Institute for many helpful discussions

I I CHAKRABORTY
P K SEN CHOWDHURY

Bose Institute Calcutta
12 5 1950

---

[1] A Big Sunspot *Nature* 165 301 February 25 1950
[2] Chakraborty I I & Chatterjee S D *Ind Jour Physics* 23 525 1949
[3] Ehmert A *Zeit F Naturforschung* 3a 14 1948

SYSTEMATIC SAMPLING III

The population to be sampled is a p dimensional rectangular field consisting of $\prod_1^p n_i$ strata each of $\prod_1^p k_i$ cells Let $(x_1\ x_2\ \ x_p)$ be the co ordinate of a cell in the field Along x direction there are n_i sets each containing k_i rectangles of (p 1) dimensions Then systematic sampling may be defined as follows from a stratum ν cells are taken at random and every k_i^{th} cell along x_i direction from every chosen cell is taken comprising a systematic sample of size $\nu \prod_1^p n_i$ (c f Das[2]) Under stratified sampling ν cells are taken at random from each stratum and under random sampling $\nu \prod_1^p n$ cells are taken at random out of all the cells in the population

This population is considered to be a sample from an infinite population in which the expectation and variance of the yield of each cell is constant and the correlation between the yield of two cells is a function of the gap between them (c f Cochran[1])

Let σ_r^2 σ_s^2 and σ_{sy}^2 be the variances of the sample mean under random stratified and systematic sampling as in Das (1949) $\rho\,(u_1\ u\ \ u_p)$ be the correlation between two points of gap $(u_1\ u_2\ \ u_p)$ and $\rho\,(u_1\ \pm u_2\ \ \pm u_p)$ is such that for $p\ \ 3$

$$\rho\,(u_1 \pm u_2 \pm u_3) \quad \rho\,(u_1\ u_2\ u_3) + \rho\,(u_1 - u_2\ u_3) + \rho\,(u_1 - u_2\ u_3) + \rho\,(u_1 - u_2\ \ u_3)$$

Let Δ_i and δ_i are the usual difference notations with respect to u_i and $\Delta_i\,\rho\,(u_2\ \pm u_3\ \ \pm u_p)$ and $\delta_i^2\,\rho\,(u_1, u_2\ \ u_p)$ be denoted by Δ_i and δ_i^2 respectively

Then σ_r^2 σ_{st}^2 and σ_{sy}^2 have been calculated and the following theorems proved giving sufficient conditions for all infinite populations

Theorem 1 If (i) $\Delta_i \leqslant 0$, and (ii) $\delta_j^2 > 0$ for $j = 1,2, \quad p$, and $j \pm i$, then stratified sampling with strips $x_i =$ const is more efficient than random sampling

Theorem 2 If (i) $\Delta_1 \leqslant 0$, (ii) $\Delta_2 \leqslant 0$ and (iii) $\delta_i^2 \geqslant 0$ for $i = 1, 2, \quad p$, then stratified sampling with strips $x_1 =$ const and $x_2 =$ const is more efficient than random sampling

We can state more general theorems equivalent to theorem 2 for stratification by stripes

Theorem 3 If (i) $\Delta_i \leqslant 0$ and (ii) $\delta_i^2 \geqslant 0$, both for $i = 1, 2, \quad p$, then stratified sampling in general is more efficient than random sampling

Theorem 4 If $\delta_i^2 > 0$ for $i = 1, 2, \quad p$, systematic sampling defined here is more efficient than stratified sampling

[N B This theorem is true even if the strata have got different expected means and variances]

Theorem 5 Under conditions of theorem 3, stated above, systematic, stratified and random sampling methods are in decreasing order of efficiency, i e $\sigma_{sy}^2 \leqslant \sigma_{st}^2 \leqslant \sigma_r^2$

A C DAS

Department of Statistics,
Calcutta University,
24 2 1950

---

[1] Cochran W G *Ann Math Stat* *17* 164 177 1946

[2] Das A C Two dimensional systematic sampling SCIENCE AND CULTURE *15* 157 158 1949

BOOK REVIEWS

The Characteristics of Electrical Discharges in Magnetic Field—By A Guthrie and R K Wakerling Published by McGraw Hill Book Co, Inc N Y Price $3 50

"The characteristics of electrical discharges in magnetic fields ' by Guthrie and Wakerling published by McGraw Hill Book Company in their Manhattan Project Technical section series supplies a book in a field where there were previously none In the rapidly growing fields of mass spectroscopy and ion accelerators the conditions under which the sources of ions operate have not received that attention it deserved until the growth of the American Manhattan project The present volume describes the work on characteristics of ion sources produced by discharges in magnetic fields by the group at Radiation larboratory at the University of California in connection with the magnetic separation of Uranium isotopes and related fields The book is comprehensive and lacking only in certain technical and engineering details which have perhaps been omitted for obvious reasons The practical experience embodied in the book will make it an obligatory reading and reference book for all those who wish to work on mass spectroscope and ion accelerators There is a last and useful chapter on the Phillips Ionization gauge for measuring high vacua which works on the principle of ionization by collision in magnetic fields This chapter though not quite related to the rest of the book is an useful addition and is the most complete description of the Philips type gauge that the reviewer has seen

In printing and the diagrams the conformity with previous volumes of the series has been maintained and the price has been kept low

B D. N.

Vaccum Equipment and Techniques—By A Guthrie and R K Wakerling Published by McGraw Hill Book Co Inc N Y Price $2 50

The publication of the volume on vacuum equipment and techniques in the Manhattan Technical series is welcome addition to the inadequate literature on this subject The first chapter on basic designs of vacuum systems is not usually met with in most books on vacuum technique It is well written and will be useful to all who want to design vacuum systems for any purpose The description of the conventional pumps in the second chapter is useful although incomplete and is not meant to be used as a guide to marketed mechanical and diffusion pumps Vacuum gauges have been fairly completely described Vacuum materials and equipment are also quite comprehensively treated as far as metal systems are concerned Glass systems however have not been dealt with and the omission I suppose has been purposely made, although the matter of insulated leads into vacuum systems, glass seals, and certain types of metal and glass systems are of importance in certain types of vacuum work The chapter on detection is again something of great usefulness to all workers in the field It is regretted that the palladium tube hydrogen ion gauge for detection of leaks which is of general interest and usefulness in this field has been overlooked

As a handbook to all those who work with evacuated systems this book will be indispensable As a manual that one can turn over at any page and use as reference it will be useful in any laboratory bookshelf The printing is good and the diagrams are clear and in comformity with the other books of the series

B. D. N.

Bengal Famine (1943)—By Tarak Chandra Das, University of Calcutta, 1949 pp 154, Price Rs 6/

The report under review is a survey of the socio economic condition of the destitutes who were driven from the villages to the city of Calcutta for food The survey was carried out by the teachers and students of the department of Anthropology of the University of Calcutta The report consists of two parts, in the first of which the destitutes have been described in detail and the second part consists of a test survey of the famine condition in a few Bengal villages

The destitutes were studied mostly in the free kitchens under the jurisdiction of District IV of Calcutta Corporation They numbered 2537 persons of which 1200 were males and 1337 females The majority (81 24%)of the above number hailed from the district of 24 Parganas, because of its close proximity and the railway system by which it is connected with the city Thanks to the railway authorities who carried these destitutes free of cost to the city and back This free railway transport was a fillip to the influx of the destitutes and its largest number from the district of 24 Parganas

Mr Das has very rightly gone into the details of the methodology of the survey and claims that the data collected by the present survey are not comparable with one of the earlier surveys on this famine It is high time therefore that all such surveys are based on an approved scientific method so that their results are comparable and show a composite picture Chap III of the report shows the age, sex and community distribution of the destitutes Mr Das has laboured very much to explain the high preponderance of males over females in the lower age groups (0 10) and that of female over males in the higher age groups He is of opinion

"Aparently, it is not due to biological causes but appears to be the result of socio economic factors produced by the famine To the reviewer, however it appears that the biological factor is the chief cause The male sex ratio is always high in the younger ages and as it is accompanied by higher male mortality than the females it is almost balanced during the reproductive periods In India we have high female mortality towards the fall of their reproductive period and the same has been found in the present destitute samples (p 46) The sex distribution found among the destitutes is entirely in conformity with our present biological knowledge and they are stronger than the socio economic reasons put forth by Mr Das The present report also shows a high male mortality (p 93) and one is reminded of Prof Crew's apt remark—the true recipe for longevity is to be born a girl"

The destitutes have been grouped into four communities—"Caste Hindus", "Scheduled Castes", 'Muslims" and 'Christians" A further subdivision of the first two groups into the different castes would have been better for purposes of indentification and understanding The reviewer is a native of a village (28 miles from Ballygunge) in 24 Parganas, which sent out a number of such destitutes and the majority of them belong to the Bagdis This caste was probably the hardest hit in this district and quite a large number of these Bagdis used to come to the town daily in the morning and go back to their villages in the evening Mr Das has mentioned (P 72) that 55 47% of the units did not possess any homestead land This is rather peculiar in a village and it is doubtful that the destitutes told the truth There are few public shelters in a village and the communal ways of livlihood among the scheduled castes of 24 Parganas are rare The destitutes have not always told the truth as the reviewer personally knows the Bagdis of his village and quite a few of them roamed about the free kitchens of Ballygunge They have posed to be destitutes in a large number of cases and came to the city owing to the high price of food stuffs, etc in the village

Mr Das has discussed at length the causes of the famine in Chap XI The most important point of Mr Das, contributory causes is the moral degeneration of the people It is doubtful how far the destitute sample were real destitutes Further, the report has not mentioned anything of the efforts in the villages to help the poor The reviewer is aware of two such benefactors in his own village — one giving dry doles and another giving *kichuri* and quite a few of the Bagdis took advantage of these and of the town as well

The report concludes with some useful suggestions in the form of long term and immediate measures in order to combat famine It appears that the primary necessity for the benefit of agriculture lies in the resuscitation of the old irrigation channels This will not involve the State into an enormous expenditure As an agriculturist the reviewer feels this to be the prime importance than the other suggestions of Mr Das which will involve a lot of social change

S S S

Artificial Radioactivity—By P B Moon, F R S Published by Cambridge Monographs on Physics Cambridge University Press 1949 Pp 102 Price 12s 6d

This Monograph on Artificial Radioactivity is a timely publication embodying our present state of knowledge on this branch of Nuclear Physics In recent years the advancement of Nuclear Physics has been so enormous and rapid that such monographs are particularly welcome by those engaged in the study of Nuclear Physics, as more comprehensive treatment of individual subjects is obtainable than available in in standard text books

This monograph gives an outline of the main phenomena and techniques of radioactivity as observed in the study of artificially radioactive nuclei A great variety of artificial radioactive nuclei has been produced in recent years and more data are pouring in At present more than 500 artificially radioactive nuclei are know[illegible] The inclusion of such a large amount of nuclear d[illegible] has not been attempted in a small volume like t[illegible]

Rather it is intended to provide a basic conception of the main radioactive processes *viz.*, electron and positron activity, K-capture and gamma emission, and the experimental data of some typical nuclei are elaborately discussed to illustrate the processes involved

The first chapter develops an introductory conception of the formation and different modes of decay of nuclei produced by artificial transmutation In chapter II the main experimental methods for detection in energy measurements of electrons, positrons and gamma rays are briefly discussed The third chapter is devoted to electron and positron emissions from nuclei A comprehensive discussion of the beta-decay theory including the K-capture process has been given and typical experimental results of a few nuclei are discussed to bring out the corelation with the theory The last chapter deals with the process of gamma emission from nuclei After a concise introduction to the theoretical aspect of gamma-emission process, follows a comprehensive discussion of some interesting gamma-emitting nuclei including those exhibiting isomeric transition

As the author has limited the discussion to light and medium heavy nuclei, the process of alpha-emission from artificially radioactive nuclei such as the transuranic elements has not been included The book includes the references of recent literature on the subject from which earlier references may be obtained This mono graph will be much helpful to those interested in the study of this branch of physics

S B

Proceedings of the National Conference on Industrial Hydraulics Vol II, 1948 Conference Secretary, Armour Research Foundation of Illinois Institute of Technology, Technology Center, Chicago 16, Illinois, U S A Paper cover, 6″ × 9″, pp xxi+154, 1949 Price $3 00

The Proceedings of the 1947 conference were reviewed in this journal some time back, (*Science and Culture*, Jan 1950, p 228) This second volume contains papers presented during Oct 20 21, 1948, and maintains the same high standard evidenced in the first volume and anticipated in the present one

As compared with ten papers in Vol I, this volume contains 13 papers which can be classified into five broad groups comprising of servomechanisms, hydraulic equipment standards, pumps and turbines, hydraulic components and recent applications The subject of servomechanisms is dealt with in two papers, one dealing with the general history and industrial applications and the other with the prediction, design and test of hydraulic mechanisms by mathematical, mechanical and electronic tools As in other fields of engineering, standardisation of hydraulic equipment is now recognised as aiming towards the advancement of the art of hydraulics, and promoting safety of personnel, uninterrupted production and a long life for machine or other equipment These aspects are covered in two general papers presenting a clear explanation of the first hydraulic standards for industrial equipment Pumps and turbines which form the veritable nerve centres of industrial hydraulics are covered in three papers They deal with the subject of hydraulic surges in pump discharge lines, prediction of liquid jet pump performance and the most recent developments in large hydraulic turbines This last subject is dealt with in a very illuminating manner wherein the advances in materials for turbine construction are surveyed These newer developments are characterised by the use of welded plate steel structures, and increased applications of stainless steel and new types of bearings and seal rings

Three papers cover the field of hydraulic components The paper on flanged joints, their development and testing will interest many technologists as their applications stretch over a very wide field The two other papers survey hydraulic packings and seals and gasket design and selection The applications of hydraulics are dealt with in two papers, one on polyphase torque converter and the other on hydraulic circuits for farm tractors

A very unusual paper for a subject like this comes from the pen of R. E Gilmer, Vice-Chairman of the U S National Security Resources Board Entitled "Our Economic Missions in Europe", the paper surveys very lucidly the purposes, benefits, difficulties and the modulus operandi of the Marshall aid Plan It is no doubt a very good paper presented in an authoritative, intelligent and clear way and would form ideal for presentation in a journal on economics and management Its relation however in this volume especially among the technical papers is a little stray and although the reviewer throughly enjoyed reading and appreciating its contents the reason for its inclusion here has left him wondering

S K G